ZooKeys 1189: 203–229 (2024)
DOI: 10.3897/zookeys.1189.115850

Research Article

Seven new species of the segmented spider genus *Liphistius* (Mesothelae, Liphistiidae) in Thailand and Myanmar

Varat Sivayyapram[1], Chawakorn Kunsete[1], Xin Xu[2], Deborah R. Smith[3], Prapun Traiyasut[4], Sureerat Deowanish[1], Mu Mu Aung[5], Hirotsugu Ono[6], Daiqin Li[7], Natapot Warrit[1,8]

1 *Center of Excellence in Entomology and Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand*
2 *College of Life Sciences, Hunan Normal University, Changsha, Hunan 410081, China*
3 *Department of Ecology & Evolutionary Biology, Haworth Hall, 1200 Sunnyside Avenue, University of Kansas, Lawrence, KS 66045, USA*
4 *Program in Biology, Faculty of Science, Ubon Ratchathani Rajabhat University, Ubon Ratchathani, Thailand*
5 *Forest Research Institute, Forest Department, Ministry of Natural Resources and Environmental Conservation, Yezin, Nay Pyi Taw, Myanmar*
6 *Department of Zoology, National Museum of Nature and Science, Tsukuba, Ibaraki 305–0005, Japan*
7 *School of Life Sciences, Hubei University, Wuhan, Hubei 430062, China*
8 *Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung 80708, Taiwan*
Corresponding author: Natapot Warrit (Natapot.W@chula.ac.th)

Abstract

Seven new species of the primitive segmented spider genus *Liphistius* are described and assigned to species groups based on characters of the male palp and vulva plate. The *bristowei* group includes *L. dawei* Sivayyapram & Warrit, **sp. nov.** (♂♀) from southeastern Myanmar, *L. choosaki* Sivayyapram & Warrit, **sp. nov.** (♀) from northwestern Thailand, and *L. lansak* Sivayyapram & Warrit, **sp. nov.** (♀) from western Thailand; the *trang* group (Complex A) contains *L. kaengkhoi* Sivayyapram & Warrit, **sp. nov.** (♂♀), *L. hintung* Sivayyapram & Warrit, **sp. nov.** (♂♀), *L. buyphradi* Sivayyapram & Warrit, **sp. nov.** (♂♀), and *L. champakpheaw* Sivayyapram & Warrit, **sp. nov.** (♂♀) from central Thailand.

Key words: Morphology, Southeast Asia, taxonomy, trapdoor spiders

OPEN ACCESS

Academic editor: Alireza Zamani
Received: 16 November 2023
Accepted: 6 December 2023
Published: 24 January 2024

ZooBank: https://zoobank.org/7C2F288F-95EB-410A-BF6E-0C13990B472F

Citation: Sivayyapram V, Kunsete C, Xu X, Smith DR, Traiyasut P, Deowanish S, Aung MM, Ono H, Li D, Warrit N (2024) Seven new species of the segmented spider genus *Liphistius* (Mesothelae, Liphistiidae) in Thailand and Myanmar. ZooKeys 1189: 203–229. https://doi.org/10.3897/zookeys.1189.115850

Copyright: © Varat Sivayyapram et al.
This is an open access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0).

Introduction

Liphistius is the sole genus of the family Liphistiidae (World Spider Catalog 2023), which, with its sister taxon Heptathelidae, comprises the suborder Mesothelae or segmented spiders, the most basal clade of living spiders (Platnick and Gertsch 1976). *Liphistius* retains several characters that are plesiomorphic among spiders, such as presence of abdominal tergites and placement of the spinnerets on the ventral median area of the abdomen (Selden 1996; Xu et al. 2015b; Selden and Ren 2017; Xu et al. 2021). All *Liphistius* species are endemic to Southeast Asia (Indonesia, Laos, Malaysia, Myanmar, Thailand) (World Spider Catalog 2023) except for *Liphistius nabang* Yu, F. Zhang & J. X. Zhang, 2021 which has been reported from Yunan, in southwestern China (Yu et al. 2021). Currently, 70 *Liphistius* species are recognized and can be classified into seven species groups based on male and female genitalia: the *batuensis* group, *birmanicus* group, *bristowei* group, *linang* group, *malayanus* group, *trang* group,

and *tioman* group (Schwendinger 1990, 2017; World Spider Catalog 2023). Here, we describe seven new *Liphistius* species from specimens deposited at the Chulalongkorn University Natural History Museum (CUMZ), Bangkok, Thailand.

Materials and methods

A total of 138 *Liphistius* specimens (104 specimens of 29 previously described species and 34 specimens of new species described here) stored in the Museum were examined and dissected for their genitalia under a Zeiss Stemi DV4 stereomicroscope. The specimens were collected between 2017–2021. The male genitalia were examined from the left palp while the vulvae were dissected from the body and cleared by digesting soft tissue using 3M potassium hydroxide. The terminology of the genital characters follows (Schwendinger and Ono 2011; Schwendinger 2017; Schwendinger et al. 2019, 2022). All measurements are reported in millimeters. The spider's body lengths do not include the chelicerae or anal tubercle. Palp and legs measurements are given in the following format: total length (femur + patella + tibia + metatarsus + tarsus). The specimens were photographed using a Canon EOS 70D DSLR camera attached to a Stackshot Macro Rail (Cognisys Inc., USA). A Canon EF 100mm f/2.8L Macro IS USM lens was attached to the camera for shooting the spider dorsal and lateral habitus. A Laowa 25mm F 2.8 2.5X–5X Macro lens was attached to the camera for shooting the spider genitalia. The photos were recorded in raw file (.CR2) then convert into TIFF file (.tiff) using Canon Digital Professional 4. Multiple digital photos were combined by the focus stacking technique using Zerene Stacker v. 1.04 (Zerene Systems LLC, USA). The stacked photos were developed (combining and removing background) and labelled in Adobe Photoshop and Adobe Illustrator programs. For species identification, the spider morphologies and genitalia were compared with the original descriptions of previously described species. To protect *Liphistius* nesting sites from poaching, the species specific collecting sites and their GPS coordinates are not presented in this article. For more specific information, please contact VS or NW directly. Thai specimens are deposited at CUMZ and the Myanmar specimens will be deposited in the Biodiversity Research Centre of Myanmar which is under construction at the site of the Forest Department, Ministry of Natural Resources and Environmental Conservation at Yezin, Nay Pyi Taw.

Comparative material examined

***Liphistius albipes* Schwendinger, 1995** – Thailand • 1♂ 2♀; Phra Chaup Khirikhan, Thap Sakae District, along rural road to Chong Lom Water Reservoir; alt. 108 m; 26 November 2017; X. Xu, F. Liu, D. Li, V. Sivayyapram leg.; ARA-2020-051, ARA-2020-052, ARA-2020-053.

***Liphistius bicoloripes* Ono, 1988** – Thailand • 2♀; Ranong, Suk Samran District, Khlong Na Kha; alt. 52 m; 21 February 2021; V. Sivayyapram leg.; ARA-2021-057, ARA-2021-058.

***Liphistius bristowei* Platnick & Sedgwick, 1984** – Thailand • 1♀; Chiang Mai, Mueang Chiang Mai District, Suthep; alt. 1110 m; 18 November 2017; X. Xu, F. Liu, D. Li, V. Sivayyapram leg.; ARA-2020-026; • 8♀; Chiang Mai, Mae Chaem District, Tha Pha; alt. 1428 m; 17 June 2019; N. Warrit, V. Sivayyapram,

C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2019-028, ARA-2019-032, ARA-2019-039, ARA-2019-040, ARA-2019-044, ARA-2019-046, ARA-2019-048, ARA-2019-050.

***Liphistius castaneus* Schwendinger, 1995** – Thailand • 2♀; Ranong, Suk Samran District, Khlong Na Kha; alt. 52 m; 21 February 2021; V. Sivayyapram, leg.; ARA-2021-065, ARA-2021-066.

***Liphistius dangrek* Schwendinger, 1996** – Thailand • 1♂ 1♀; Ubon Ratchathani, Na Chaluai District, Na Chaluai; alt. 354 m; 11 November 2018; P. Traiyasut leg.; ARA-2020-058, ARA-202-059.

***Liphistius erawan* Schwendinger, 1996** – Thailand • 2♀; Kanchanaburi, Si Sawat District, Tha Kradan; alt. 272 m; 15 November 2017; X. Xu, F. Liu, D. Li, V. Sivayyapram leg.; ARA-2020-045, ARA-2020-046; • 1♂ 2♀; Kanchanaburi, Si Sawat District, Tha Kradan; alt. 229 m; 20 September 2018; V. Sivayyapram, C. Kunsete, W. Nawanetiwong leg.; ARA-2018-260, ARA-2018-261, ARA-2018-263; • 1♂ 2♀; Kanchanaburi, Sai Yok District, Tha Sao; alt. 380 m; 15 November 2018; V. Sivayyapram, C. Kunsete, W. Nawanetiwong leg.; ARA-2018-314, ARA-2018-315, ARA-2018-319; • 1♂ 2♀; Kanchanaburi, Sai Yok District, Tha Sao; alt. 158 m.; 27 January 2016; N. Warrit, V. Sivayyapram leg.; ARA-2017-118; ARA-2017-125; ARA-2017-127.

***Liphistius fuscus* Schwendinger, 1995** – Thailand • 2♀; Krabi, Mueang Krabi District, Thab Prik; alt. 307 m; 20 February 2021; V. Sivayyapram leg.; ARA-2020-047, ARA-2020-048.

***Liphistius hatyai* Zhan & Xu, 2022** – Thailand • 2♂ 1♀; Songkhla, Hat Yai District, Kho Hong; alt. 162 m; 13 November 2016; N. Warrit, V. Sivayyapram, N. Chatthanabun, P. Traiyasut leg.; ARA-2017-121, ARA-2017-122, ARA-2017-123.

***Liphistius indra* Schwendinger, 2017** – Thailand • 5♀; Pattani, Khok Pho District, Sai Khao; alt. 83 m; 17 February 2021; V. Sivayyapram leg.; ARA-2021-001, ARA-2021-004, ARA-2021-006, ARA-2021-007, ARA-2021-010.

***Liphistius isan* Schwendinger, 1998** – Thailand • 1♀; Sakon Nakhon, Mueang Sakon Nakhon District, Huai Yang; alt. 308 m; 24 May 2018; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2018-194.

***Liphistius jarujini* Ono, 1988** – Thailand • 1♀; Mueang Tak District, Mae Tho; alt. 881 m; 16 November 2017; X. Xu, F. Liu, D. Li, V. Sivayyapram leg.; ARA-2020-017.

***Liphistius keeratikiati* Zhan & Xu, 2022** – Thailand • 3♀; Chumphon, Sawi District, Thung Raya; alt. 48 m; 4 May 2018; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2018-027, ARA-2018-028, ARA-2018-033.

***Liphistius lahu* Schwendinger, 1998** – Thailand • 1♀; Chiang Mai, Fang District, Ang Kang; alt. 1646 m; 21 November 2017; X. Xu, F. Liu, D. Li, V. Sivayyapram leg.; ARA-2020-028.

***Liphistius maewongensis* Sivayyapram** et al., **2017** – Thailand • 1♂ 2♀; Kampang Phet, Klonglan District, Mae Wong National Park, 16.09°N, 99.12°E; alt. 946 m; 4 May 2018; N. Warrit, V. Sivayyapram, N. Chatthanabun leg.; ARA-2017-001, ARA-2017-002, ARA-2017-003.

***Liphistius marginatus* Schwendinger, 1990** – Thailand • 1♂ 1♀; Tak, Mueang Tak District, Mae Tho; alt. 868 m; 20 September 2017; N. Chomphuphuang, C. Songsangchote leg.; ARA-2017-124, ARA-2017-125.

***Liphistius nesioticus* Schwendinger, 1996** – Thailand • 2♀; Trat, Ko Chang District, Ko Chang, along rural road; alt. 84 m; 28 November 2017; X. Xu, F. Liu, D. Li, C. Kunsete leg.; ARA-2020-032, ARA-2020-043.

***Liphistius niphanae* Ono, 1988** – Thailand • 4♀; Nakhon Si Thammarat, Lansaka District, Khao Kaeo; alt. 112 m; 23 January 2018; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2018-038, ARA-2018-039, ARA-2018-040, ARA-2018-041; • 2♀; Nakhon Si Thammarat, Nopphitam District, Nopphitam; alt. 248 m; 15 February 2021; V. Sivayyapram leg.; ARA-2021-020, ARA-2021-021.

***Liphistius onoi* Schwendinger, 1996** – Thailand • 3♀; Phitsanulok, Nakhon Thai District, Noen Phoem; alt. 1238 m; June 2017; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2020-055, ARA-2020-056, ARA-2020-057.

***Liphistius ornatus* Ono & Schwendinger, 1990** – Thailand • 7♀; Chanthaburi, Khao Khitchakut District, Pluang; alt. 79 m; 17 March 2018; N. Warrit, V. Sivayyapram, C. Kunsete, N. Chatthanabun, P. Traiyasut leg.; ARA-2018-106, ARA-2018-107, ARA-2018-108, ARA-2018-109, ARA-2018-110, ARA-2018-112, ARA-2018-114; • 1♂; Chanthaburi, Khao Khitchakut District, Pluang; alt. 79 m; 26 October 2021; N. Warrit, C. Kunsete, W. Nawanetiwong leg.; ARA-2021-078.

***Liphistius phuketensis* Schwendinger, 1998** – Thailand • 3♀; Phuket, Thalang District, Thep Krasatti; alt. 89 m; 23 November 2017; X. Xu, F. Liu, D. Li, V. Sivayyapram leg.; ARA-2020-020, ARA-2020-021, ARA-2020-022.

***Liphistius sayam* Schwendinger, 1998** – Thailand • 2♀; Chon Buri, Si Racha District, Bang Phra; alt. 326 m; 18 March 2018; N. Warrit, V. Sivayyapram, C. Kunsete, N. Chatthanabun, P. Traiyasut leg.; ARA-2018-204, ARA-2018-205.

***Liphistius schwendingeri* Ono, 1988** – Thailand • 3♀; Ranong, Suk Samran District, Khlong Na Kha; alt. 52 m; 22 January 2018; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2018-027, ARA-2018-028, ARA-2018-033.

***Liphistius tenuis* Schwendinger, 1996** – Thailand • 3♀; Chanthaburi, Laem Sing District, Phliu; alt. 69 m; 6 February 2017; N. Warrit, V. Sivayyapram, P. Traiyasut leg.; ARA-2017-158, ARA-2017-159, ARA-2017-160.

***Liphistius thaleri* Schwendinger, 2009** – Thailand • 5♀; Trang, Kantang District, Libong Island; alt. 37 m; 18 February 2021; V. Sivayyapram leg.; ARA-2021-022, ARA-2021-023, ARA-2021-024, ARA-2021-025, ARA-2021-028.

***Liphistius tham* Sedgwick & Schwendinger, 1990** – Thailand • 2♀; Saraburi, Kaeng Khoi District, Thap Kwang, Kaeng; alt. 280 m; V. Sivayyapram leg.; ARA-2021-073, ARA-2021-074.

***Liphistius thoranie* Schwendinger, 1996** – Thailand • 1♂; Nakhon Ratchasima, Mueang Nakhon Nayok, Hin Tung; alt. 1171 m; July 2017; C. Songsangchote leg.; ARA-2020-054; • 1♀; Nakhon Ratchasima, Mueang Nakhon Nayok, Hin Tung; alt. 754 m; 9 October 2016; N. Warrit, V. Sivayyapram, P. Traiyasut leg.; ARA-2020-041.

***Liphistius trang* Platnick & Sedgwick, 1984** – Thailand • 4♀; Trang, Na Yong District, Chong; alt. 161 m; 23 January 2018; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2018-050, ARA-2018-051, ARA-2018-052, ARA-2018-055.

***Liphistius yamasakii* Ono, 1988** – Thailand • 5♀; Chiang Mai, Mae Chaem District, Tha Pha; alt. 1428 m; 13 June 2019; N. Warrit, V. Sivayyapram,

C. Kunsete, W. Nawanetiwong, P. Traiyasut leg.; ARA-2019-016, ARA-2019-017, ARA-2019-019, ARA-2019-021, ARA-2019-024 • 1♂1♀; Chiang Mai, Mae Chaem District, Tha Pha; alt. 1428 m; 28 October 2020; C. Kunsete, W. Nawanetiwong leg.; ARA-2021-076, ARA-2021-077.

***Liphistius yangae* Platnick & Sedgwick, 1984** – Thailand • 1♂; Satun, Khuan Don District, Wang Prachan; alt. 117 m; 25 January 2018; N. Warrit, V. Sivayyapram, C. Kunsete, W. Nawanetiwong leg.; ARA-2018-062; • 3♀; Songkhla, Hat Yai District, Hat Yai; alt. 37 m; 30 December 2018; C. Kunsete leg.; ARA-2018-370, ARA-2018-372, ARA-2018-377.

Systematics

Family Liphistiidae Thorell, 1869

Genus *Liphistius* Schiødte, 1849

Type species. *Liphistius desultor* Schiødte, 1849.

Diagnosis. *Liphistius* can be distinguished from the heptathelid genera by the male palp possessing a tibial apophysis; the vulva modified into a pore plate or plate-like spermatheca; and the nest structure equipped with signal lines, unique silk lines radiating from the burrow entrance (Platnick and Sedgwick 1984; Xu et al. 2015a).

Distribution. China (Yunnan Province), Indonesia (Sumatra), Laos, Peninsular Malaysia, Myanmar, and Thailand.

***Liphistius dawei* Sivayyapram & Warrit, sp. nov.**

https://zoobank.org/9F369E2C-F3DB-4F63-ADE1-E4FD4C7F063B

Figs 1–3

Type material. ***Holotype*:** Myanmar • 1♂; Dawei, Pa Kar Ri; alt. 20 m; 4 May 2018; N. Warrit, V. Sivayyapram, C. Kunsete, N. Chatthanabun, P. Traiyasut leg.; ARA-2018-143. ***Allotype*:** Myanmar • 1♀; same data as for the holotype; ARA-2018-138. ***Paratypes*:** Myanmar • 1♂ 5♀; same data as for the holotype; ARA-2018-136, ARA-2018-137, ARA-2018-139, ARA-2018-140, ARA-2018-144, ARA-2018-147.

Other material. Myanmar • 3 juveniles; same data as for the holotype; ARA-2018-146, ARA-2018-148, ARA-2018-149.

Diagnosis. *Liphistius dawei* sp. nov. is similar to *L. inthanon* Zhan & Xu, 2022 and *L. yamasakii* Ono, 1988 in large body size with uniformly dark color. The male of *L. dawei* sp. nov. can be distinguished from those of *L. inthanon* and *L. yamasakii* by the palp: subtegulum with moderate apophysis, not enlarged at the tip; tegulum with finer dentate edge of proximal margin and more pronounced marginal apophysis (Fig. 3A–D; Ono 1988: fig. 8; Schwendinger 1990: fig. 18; Zhan et al. 2022: fig. 4A–G). The female of *L. dawei* sp. nov. can be distinguished from those of *L. inthanon* and *L. yamasakii* by the vulva: posterior stalk axe-blade shaped, constricted at the base; pore plate with less projecting posterior corners of the lateral lips (Fig. 3E, F; Ono 1988: figs 6, 7; Schwendinger 1990: fig. 19; Zhan et al. 2022: fig. 4H–M).

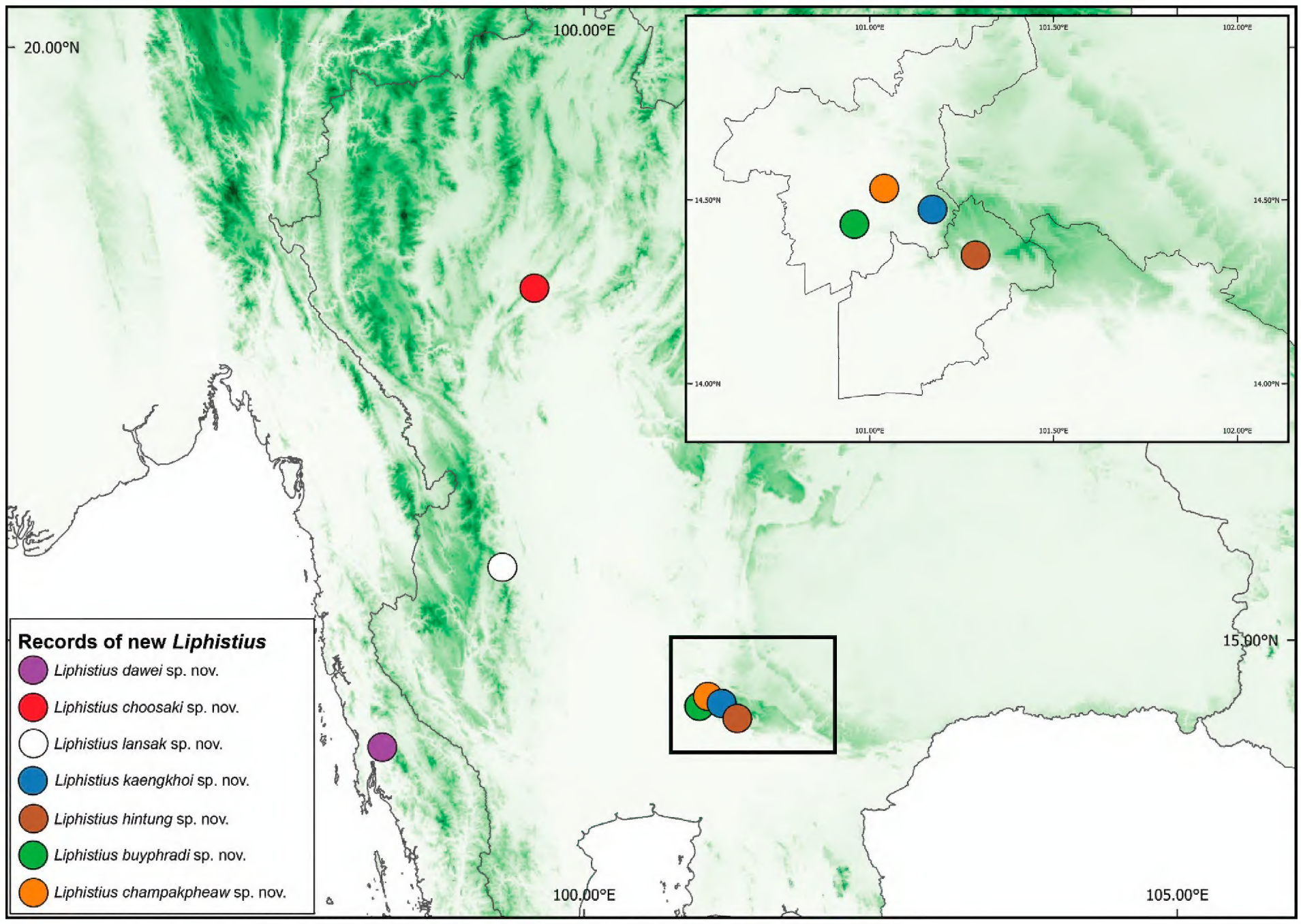

Figure 1. Map showing the localities of the new *Liphistius* species described.

Description. Male (Holotype: ARA-2018-143; Fig. 2A). ***Coloration (in alcohol)*:** carapace uniformly brown, with black stripe along the margins, bearing short black setae on cephalic region and coxal elevations; abdominal tergite brown, bearing short black setae, paler on the glabrous area; membranous part of the opisthosoma cream color with a smear of black pigment; chelicerae pale brown; palp and legs pale brown, without distinct annulations.

Palp (Fig. 3A–D): tibial apophysis short, truncate, carrying four black tapering megaspines; cumulus distinctly elevated, bearing long black bristles; paracymbium long, narrow, dark patch with spicules partially isolated by a pale band; subtegulum with moderated apophysis, not enlarged at the tip; contrategulum without apophysis, distal edge of contrategulum arched, leading to conical apex; tegulum kidney-shaped, wider than long, proximal margin convex with finely dentate edge, distal margin slightly concave with round and pronounced apophysis; pigmental bridge between contrategulum and tegulum indistinct; paraembolic plate indistinct, not projecting into a scale-like plate, sclerotized part of the embolus with two longitudinal ridges reaching to the tip.

***Measurements*:** Total length 20.15; carapace 9.75 long, 9.10 wide; opisthosoma 9.36 long, 7.28 wide; ocular tubercle 1.30 long, 1.56 wide; palpal coxa 3.12 long, 1.82 wide; labium 1.04 long, 1.82 wide; sternum 4.55 long, 2.73 wide (1.43 on ventral surface); palp 16.90 long (5.59 + 3.38 + 5.33 + – + 2.60); leg I 28.21 long (8.58 + 4.16 + 5.85 + 7.02 + 2.60); leg II 30.42 long (8.97 + 4.03 + 6.50 + 7.93 + 2.93); leg III 32.04 long (8.58 + 4.16 + 6.50 + 7.93 + 2.93); leg IV 39.91 long (10.7 + 4.29 + 8.19 + 12.48 + 4.68).

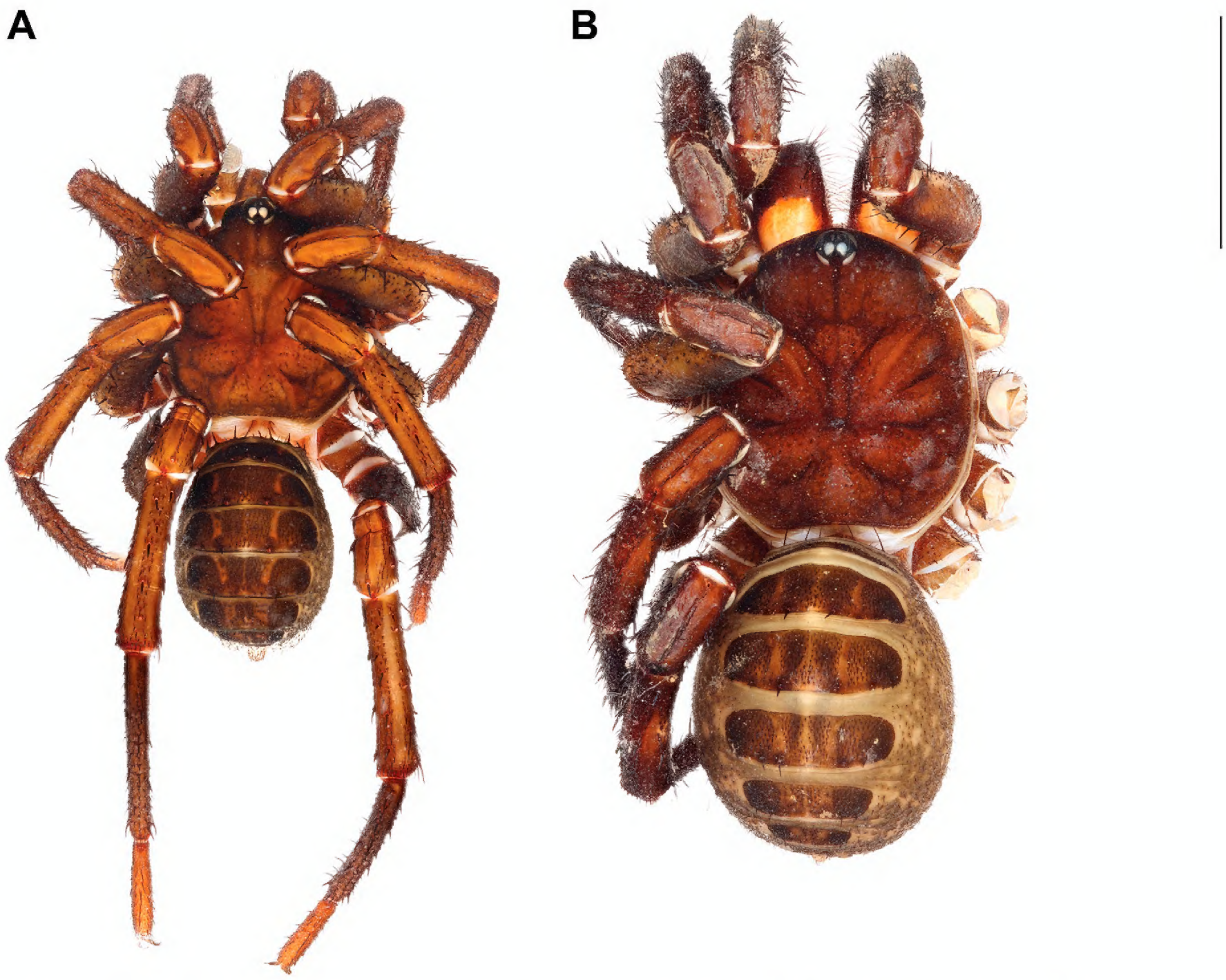

Figure 2. *Liphistius dawei* sp. nov. dorsal habitus **A** male, ARA-2018-143 (holotype) **B** female, ARA-2018-138 (allotype). Scale bar: 10 mm.

Female (Allotype: ARA-2018-138; Fig. 2B). ***Coloration (in alcohol)*:** carapace uniformly brown, bearing short black setae on the cephalic region and coxal elevations; abdominal tergites brown, darker in the area with short black setae; membranous part of the opisthosoma cream colored with thin layer of smear black marking; chelicerae bicolor, orange on proximal part and brown on distal part; palp and legs brown, without distinct annulations.

Vulva (Fig. 3E, F): vulva plate hexagonal, genital atrium with folded lateral margins, carrying lateral hairs; posterior stalk axe-blade shaped, constricted at the based, posterior margin convex; pore plate rectangular and wider than long, lateral margin thickened and projecting into a lips, more distinct on anterior portion, posterior corner slightly projecting, anterior margin thickened and projecting into a lip, slightly arched; receptacular cluster racemose, longer than wide; central dorsal opening wide longer than wide.

***Measurements*:** Total length 27.43; carapace 12.87 long, 12.09 wide; opisthosoma 14.04 long, 11.44 wide; ocular tubercle 1.69 long, 1.95 wide; palpal coxa 4.42 long, 2.47 wide; labium 1.82 long, 3.12 wide; sternum 6.24 long, 3.51 wide (2.08 on ventral surface); palp 22.23 long (8.06 + 4.16 + 5.07 + – + 4.94); leg I 28.47 long (9.75 + 4.94 + 5.98 + 5.46 + 2.34); leg II 29.51 long (9.62 + 5.07 + 5.98 + 5.72 + 3.12); leg III 30.42 long (8.97 + 5.33 + 5.85 + 7.28 + 2.99); leg IV 41.34 long (11.44 + 5.46 + 7.80 + 12.09 + 4.55).

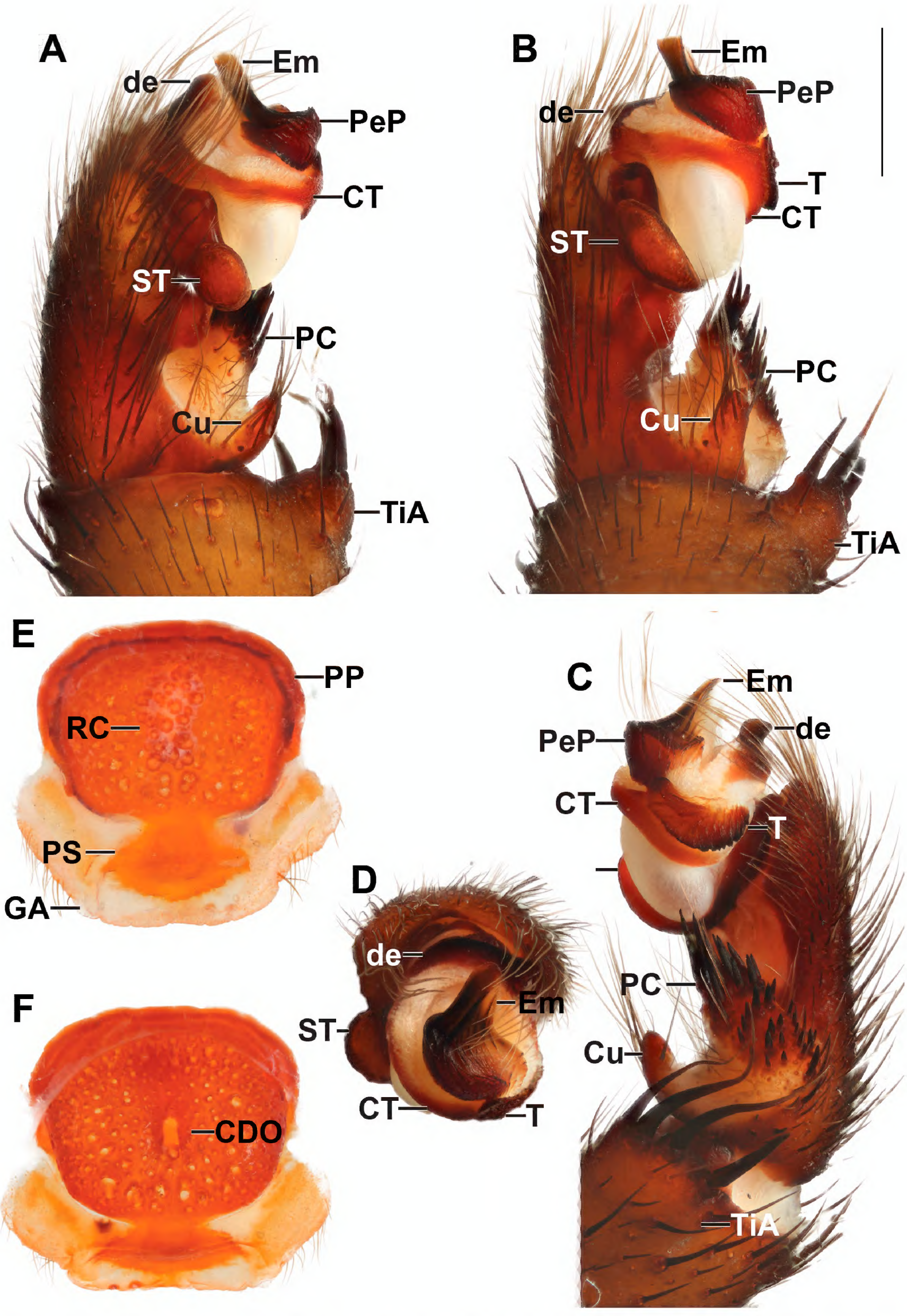

Figure 3. *Liphistius dawei* sp. nov. male palp and vulva plate **A–D** ARA-2018-143 (holotype) palp **A** prolateral view **B** ventral view **C** retrolateral view **D** distal view **E, F** ARA-2018-138 (allotype) vulva plate **E** ventral view **F** dorsal view. Abbreviations: CDO = central dorsal opening; CT = contrategulum; Cu = cumulus; de = distal edge of the contrategulum; Em = embolus; GA = genital atrium; mm = millimeter; PC = paracymbium; PeP = paraembolic plate; PP = poreplate; PS = posterior stalk; RC = receptacular cluster; ST = subtegulum; T = tegulum; TiA = tibial apophysis. Scale bar: 1 mm.

Etymology. The specific epithet *dawei* refers to the type locality of the new species in Dawei State, Myanmar.

Distribution. Known only from the type locality.

Comment. The new species was mentioned as *Liphistius* sp. DW in Sivayyapram et al. (2023).

***Liphistius choosaki* Sivayyapram & Warrit, sp. nov.**

https://zoobank.org/B14F4BAB-5156-479D-93E0-5CDE9F8C2A50

Figs 1, 4

Type material. ***Holotype*:** Thailand • 1♀; Phrae, Wang Chin District, Mae Koeng; alt. 265 m; 5 October 2019; N. Warrit, V. Sivayyapram, C. Kunsete, N. Chatthanabun, P. Traiyasut leg.; ARA-2019-057. ***Paratype*:** Thailand • 1♀; same data as for the holotype; ARA-2019-056.

Other materials. Thailand • 3 juveniles; same data as for the holotype; ARA-2019-059, ARA-2019-061, ARA-2019-062.

Diagnosis. *Liphistius choosaki* sp. nov. is similar to *L. dawei* sp. nov., *L. inthanon*, and *L. yamasakii* in its uniformly dark coloration. The female of *L. choosaki* sp. nov. can be distinguished from those of *L. dawei*, *L. inthanon*, and *L. yamasakii* by the characters of vulva: pore plate distinctly wider than long with almost straight anterior margin; and by its larger body size.

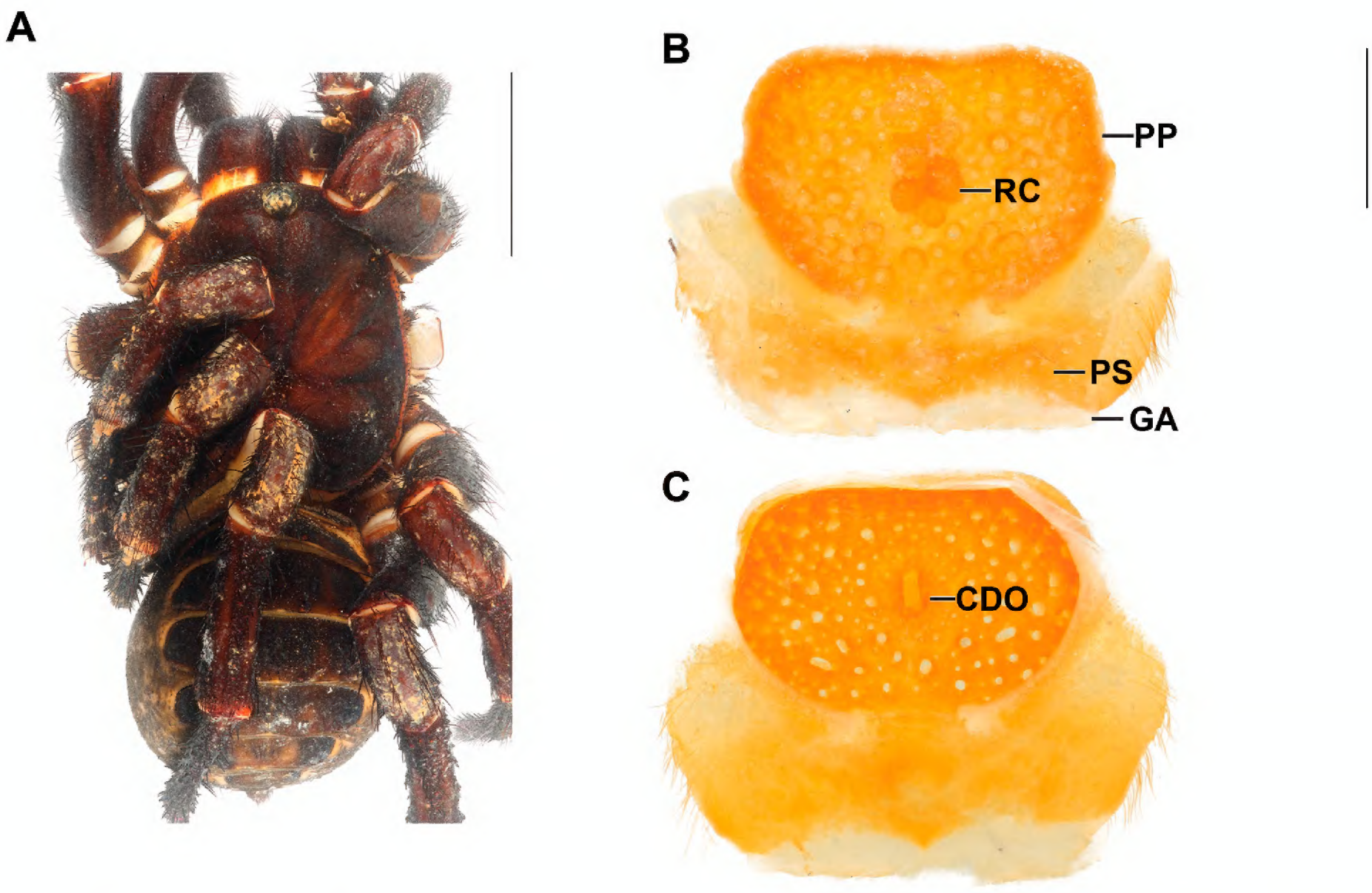

Figure 4. *Liphistius choosaki* sp. nov. female, ARA-2019-057 (holotype) **A** dorsal view **B, C** vulva plate **B** ventral view **C** dorsal view. Abbreviations: CDO = central dorsal opening; GA = genital atrium; mm = millimeter; PP = poreplate; PS = posterior stalk; RC = receptacular cluster. Scale bars: 10 mm (**A**); 1 mm (**B, C**).

Description. Male. Unknown.

Female (Holotype: ARA-2019-057; Fig. 4A). ***Coloration (in alcohol)*:** carapace uniformly brown; abdominal tergites dark brown; membranous part of the opisthosoma cream color with thin mottled black marking; chelicerae bicolor, orange on proximal part and dark brown on distal part; palp and legs brown, without distinct annulations.

Vulva (Fig. 4B, C): vulva plate hexagonal, genital atrium with folded lateral margins, carrying lateral hairs; posterior stalk very wide, M-shaped posterior margin; pore plate rectangular, wider than long, lateral margin convex, anterior margin almost straight, all margins thickened and projected into a lip; receptacular cluster racemose, longer than wide; central dorsal opening wide longer than wide.

***Measurements*:** Total length 36.40; carapace 18.33 long, 16.38 wide; opisthosoma 17.94 long, 15.34 wide; ocular tubercle 1.82 long, 1.95 wide; palpal coxa 5.46 long, 3.25 wide; labium 2.08 long, 4.29 wide; sternum 9.75 long, 3.90 wide (1.95 on ventral surface); palp 29.12 long (10.66 + 5.59 + 7.02 + – + 5.85); leg I 34.71 long (12.48 + 6.50 + 7.15 + 6.24 + 2.34); leg II 36.40 long (11.96 + 5.85 + 7.41 +7.54 +3.64); leg III 40.82 long (12.74 + 6.89 + 7.67 + 9.49 + 4.03); leg IV 53.69 long (15.21 + 7.41 + 10.79 + 14.95 + 5.33).

Etymology. The specific epithet *choosaki* honors the late Mr. Choosak Pungrusmee, father to Mr. Sarawut Pungrusmee and dedicated philanthropist to the study of biodiversity in our research laboratory.

Distribution. Known only from the type locality.

Comment. This new species name was mentioned as *Liphistius* sp. WKS in Sivayyapram et al. (2023).

Liphistius lansak Sivayyapram & Warrit, sp. nov.

http://zoobank.org/49787452-9ACB-4BB4-AD78-006CE5A02D25

Figs 1, 5

Type material. *Holotype*: Thailand • 1♀; Uthai Thani, Lan Sak District, Rabam; alt. 200 m; 29 October 2020; V. Sivayyapram leg.; ARA-2021-067. ***Paratype*:** Thailand • 1♀, same data as for the holotype; ARA-2021-068.

Diagnosis. *Liphistius lansak* sp. nov. is a small *Liphistius* species recognized by the unique vulva: pore plate with receptacular cluster flanked by a pair of large vesicles.

Description. Male. Unknown.

Female (Holotype: ARA-2021-067; Fig. 5A, B). ***Coloration (in alcohol)*:** carapace pale brown with black marking on the cephalic region and the margin of the thoracic region; abdominal tergites pale brown, with black marking on the anterior and lateral margins of each plate; membranous part of the opisthosoma cream colored with thin mottled black marking; chelicerae dark brown, with black marking, except on the proximal part; palp and legs pale brown, with black annulations on the proximal and distal part of each joint (Fig. 5B).

Vulva (Fig. 5C, D): vulva plate hexagonal, wider than long, genital atrium without lateral hair; posterior stalk short but wide, posterior margin W-shaped; pore plate rectangular, wider than long, lateral margin not projected into a lip, anterior margin invaginated, thickened and projected into a lip; receptacular cluster

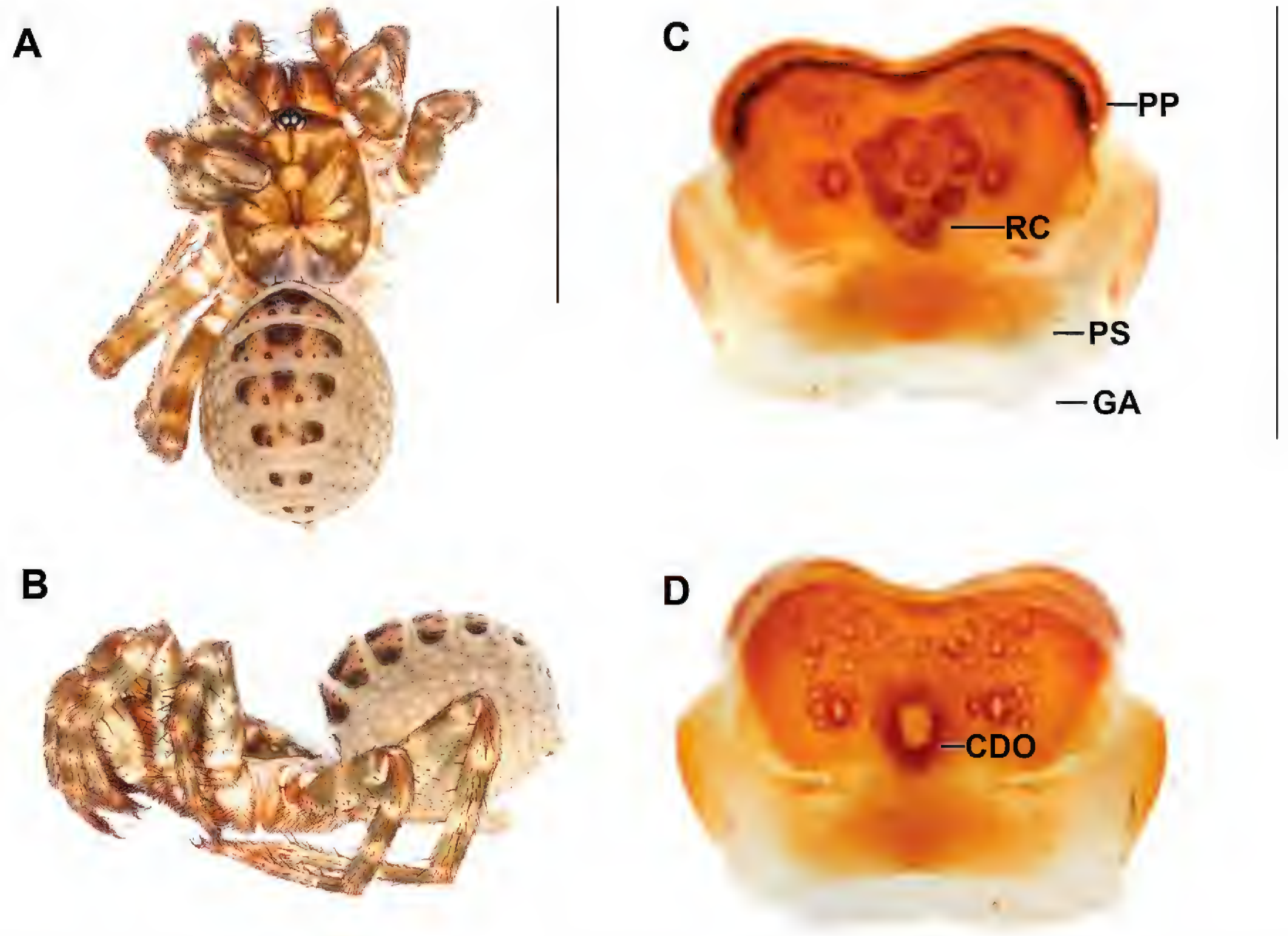

Figure 5. *Liphistius lansak* sp. nov. **A, B** female, ARA-2021-068 (holotype) **A** dorsal view **B** lateral view **C, D** vulva plate **C** ventral view **D** dorsal view. Abbreviations: CDO = central dorsal opening; GA = genital atrium; mm = millimeter; PP = poreplate; PS = posterior stalk; RC = receptacular cluster. Scale bars: 10 mm (**A, B**); 1 mm (**C, D**).

racemose, as long as wide, flanked by a pair of large vesicles; central dorsal opening round and wide.

***Measurements*:** Total length 14.17; carapace 5.98 long, 5.46 wide; opisthosoma 8.19 long, 6.89 wide; ocular tubercle 0.91 long, 1.04 wide; palpal coxa 2.21 long, 1.17 wide; labium 0.78 long, 1.82 wide; sternum 3.12 long, 1.95 wide (1.30 on ventral surface); palp 10.79 long (3.77 + 1.95 + 2.47 + – + 2.60); leg I 14.04 long (4.55 + 2.08 + 2.86 + 2.99 + 1.56); leg II 15.08 long (4.81 + 2.21 + 2.99 + 3.38 + 1.56); leg III 17.16 long (4.68 + 2.47 + 3.25 + 4.03 + 2.73); leg IV 20.94 long (5.33 + 2.47 + 4.03 + 5.98 + 3.13).

Etymology. The specific epithet *lansak* refers to Lan Sak District, the type locality of the new species in Uthai Thani, Thailand.

Distribution. Known only from the type locality.

Comment. This new species name was mentioned as *Liphistius* sp. HKK in Sivayyapram et al. (2023).

***Liphistius kaengkhoi* Sivayyapram & Warrit, sp. nov.**

https://zoobank.org/BA62345B-B964-4845-B248-147400A0FAE6

Figs 1, 6, 7, 14

Type material. *Holotype*: THAILAND • 1♂; Saraburi, Kaeng Khoi District, Cha Om; alt. 127 m; 14 October 2018; N. Warrit, V. Sivayyapram, C. Kunsete,

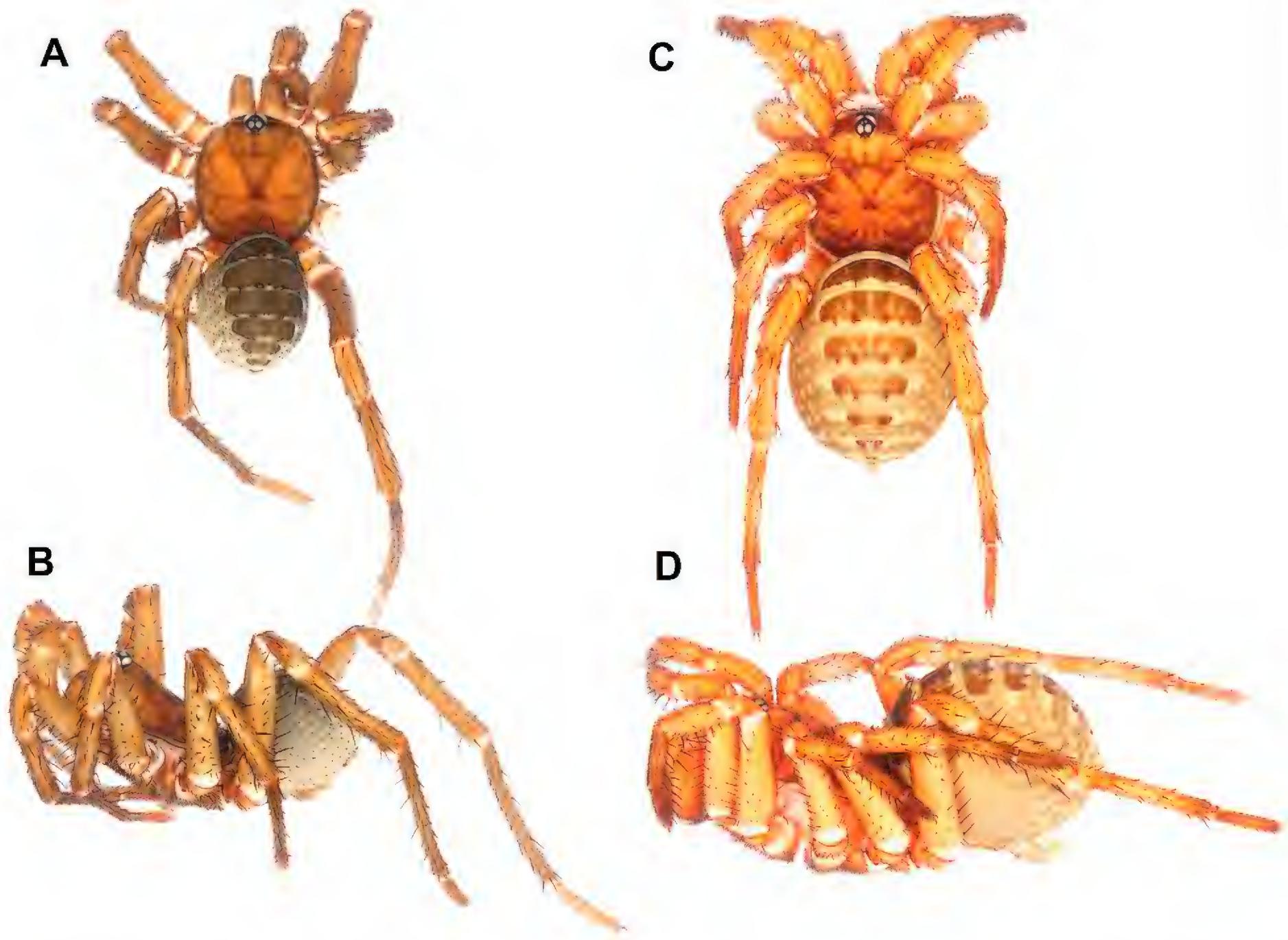

Figure 6. *Liphistius kaengkhoi* sp. nov. **A, B** male ARA-2018-284 (holotype) **C, D** female, ARA-2018-286 (allotype) **A, C** dorsal view **B, D** lateral view. Scale bar: 10 mm.

N. Chatthanabun, P. Traiyasut leg.; ARA-2018-284. ***Allotype*:** Thailand • 1♀, same data as for the holotype; ARA-2018-286. ***Paratypes*:** Thailand • 2♂ 4♀; same data as for the holotype; ARA-2018-281, ARA-2018-282, ARA-2018-283, ARA-2018-285, ARA-2018-289, ARA-2018-291.

Diagnosis. *Liphistius kaengkhoi* sp. nov. is similar to *L. buyphradi* sp. nov., *L. champakpheaw* sp. nov., *L. hintung* sp. nov., and *L. suwat* Schwendinger, 1996 in general appearance. The male of *L. kaengkhoi* sp. nov. can be distinguished from that of *L. suwat* by the paracymbium not bent outward; and the contrategulum without short blunt cone (Fig. 7; Schwendinger 1996: figs 43, 43A); from those of *L. buyphradi* sp. nov. and *L. champakpheaw* sp. nov. by the male palp with swollen paracymbium (flat in *L. buyphradi* sp. nov., *L. champakpheaw* sp. nov.; Figs 11, 13); *L. kaengkhoi* sp. nov. is very similar to *L. hintung* sp. nov. but can be distinguished by the shorter and finer dentate edge on the proximal margin of the tegulum and shorter paraembolic plate (Figs 7A–D, 9A–D). The female *L. kaengkhoi* sp. nov. is difficult to distinguish from those of the *L. buyphradi* sp. nov., *L. champakpheaw* sp. nov., *L. hintung* sp. nov., and *L. suwat* Schwendinger, 1996. Molecular phylogeny and species delimitation using *COI* and multi-locus data support monophyly and species status of all new species described here (Sivayyapram et al. 2023).

Description. Male (Holotype: ARA-2018-284; Fig. 6A, B). ***Coloration (in alcohol)*:** carapace brown with indistinct black mottling on cephalic region

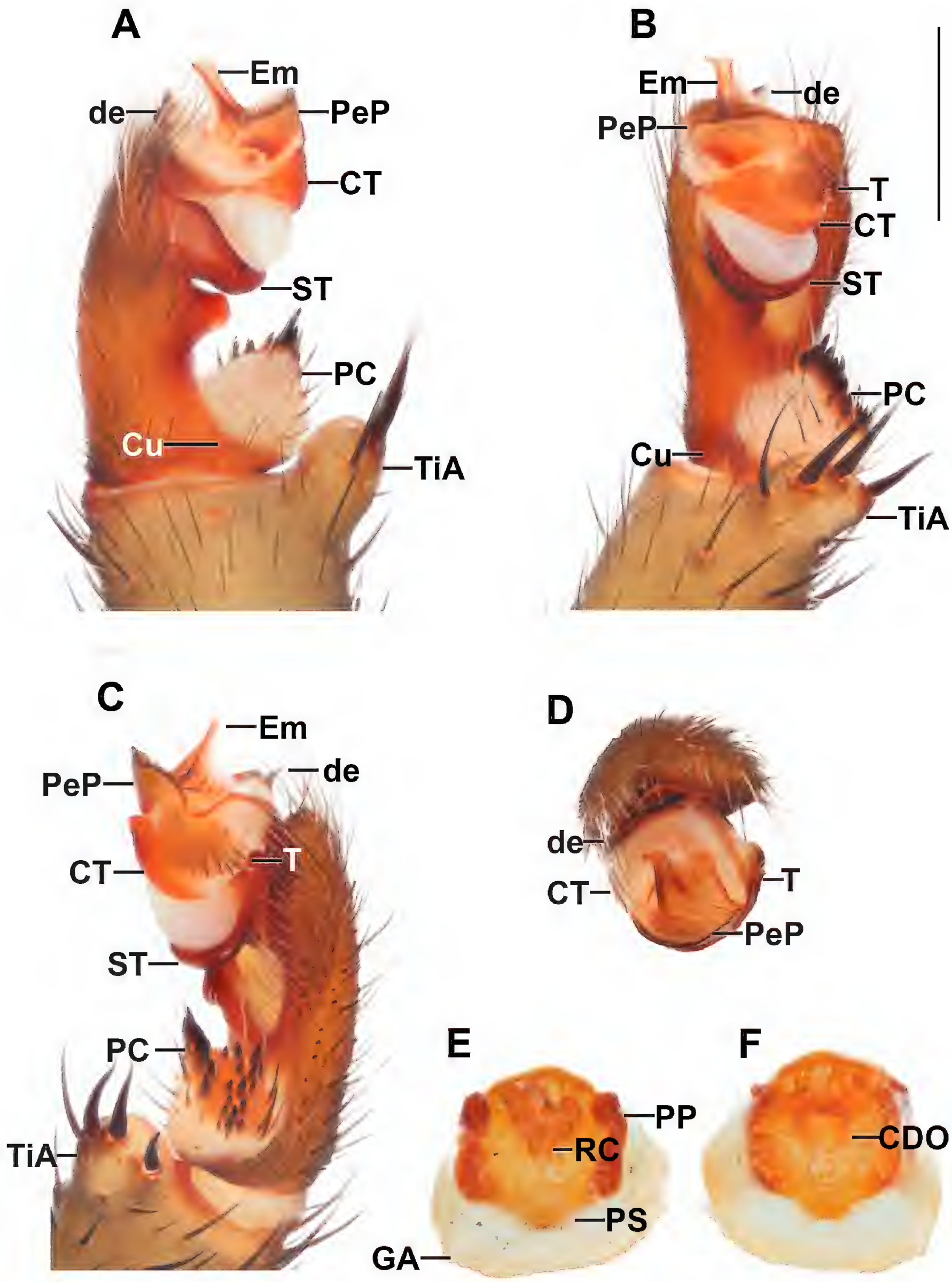

Figure 7. *Liphistius kaengkhoi* sp. nov. male palp and vulva plate **A–D** ARA-2018-284 (holotype) palp **A** prolateral view **B** ventral view **C** retrolateral view **D** distal view **E, F** ARA-2018-286 (allotype) vulva plate **E** ventral view **F** dorsal view. Abbreviations: CDO = central dorsal opening; CT = contrategulum; Cu = cumulus; de = distal edge of the contrategulum; Em = embolus; GA = genital atrium; mm = millimeter; PC = paracymbium; PeP = paraembolic plate; PP = poreplate; PS = posterior stalk; RC = receptacular cluster; ST = subtegulum; T = tegulum; TiA = tibial apophysis. Scale bar: 1 mm.

and coxal elevations; abdominal tergites black; membranous part of the opisthosoma cream colored with black mottling on antero-dorsal portion; chelicerae brown, paler on proximal portion; palp and legs brown without distinct annulation.

Palp (Fig. 7A–D): tibial apophysis large, carrying one long slender and three tapering megaspines; paracymbium short, almost round, dark patch with spicules isolated by a pale band; cumulus plain, bearing thin black bristles; subtegulum without apophysis; contrategulum without apophysis, distal edge of contrategulum long, slightly invaginate leading to the conical apex; tegulum large, axe-blade shaped, indistinctly separated from the contrategulum by corrugated surface, proximal margin with a short moderate dentate edge, distal margin almost straight, with round apophysis; pigmental bridge between tegulum and contrategulum sigmoid in shape; paraembolic plate projecting to a scale-liked plate, basally wide, leading into short triangular distal margin; embolus proper: sclerotized part with two longitudinal ridges reaching to the truncated apex.

***Measurements*:** Total length 11.44; carapace 5.85 long, 5.72 wide; opisthosoma 5.82 long, 5.07 wide; ocular tubercle 0.97 long, 1.17 wide; palpal coxa 2.21 long, 1.30 wide; labium 0.65 long, 1.3 wide; sternum 3.99 long, 1.95 wide (0.91 on ventral surface); palp 12.09 long (3.90 + 2.21 + 3.90 + – + 2.08); leg I 18.72 long (5.72 + 2.73 + 3.77 + 4.42 + 2.08); leg II 19.50 long (5.72 + 2.60 + 3.90 + 4.81 + 2.47); leg III 20.80 long (5.46 + 2.60 + 4.29 + 5.85 + 2.60); leg IV 26.25 long (6.89 + 2.99 + 5.20 + 7.67 + 3.51).

Female (Allotype: ARA-2018-286; Fig. 6C, D). ***Coloration (in alcohol)*:** carapace orange with thick black band on the anterior margin and black mottled marking in the posterior portion of the cephalic region and the thoracic region; abdominal tergites cream colored with large mottled black markings; membranous part of the opisthosoma cream with black mottled marking; chelicerae orange; palp and legs: femur to tibia orange, tarsi and metatarsi of legs I–III black, metatarsi of leg IV orange with black annulation on the proximal and distal area.

Vulva (Fig. 7E, F): vulva plate almost round, genital atrium without lateral hair; posterior stalk short, V-shaped; pore plate rectangular, lateral margins thickened and project into lips, anterior margin convex, less thicken, not project into a lip; receptacular clusters racemose, grape-like in shape; central dorsal opening wide.

***Measurements*:** Total length 16.2; carapace 6.89 long, 6.50 wide; opisthosoma 9.49 long, 9.67 wide; ocular tubercle 1.04 long, 1.04 wide; palpal coxa 2.60 long, 1.56 wide; labium 0.78 long, 1.95 wide; sternum 3.64 long, 2.21 wide (1.30 on ventral surface); palp 12.87 long (4.68 + 2.47 + 2.86 + – + 2.86); leg I 15.47 long (5.20+ 2.86 + 2.99 + 2.86 + 1.56); leg II 15.99 long (5.20 + 2.73 + 2.99 + 3.25 + 1.82); leg III 16.64 long (5.07 + 2.60 + 3.12 + 3.77 + 2.08); leg IV 23.81 long (7.02 + 3.38 + 4.18 + 6.24 + 2.99).

Etymology. The specific epithet *kaengkhoi* refers to Kaeng Khoi District, the type locality of the new species in Saraburi, Thailand.

Distribution. Known only from the type locality.

Comment. This new species name was mentioned as *Liphistius* sp. CK in Sivayyapram et al. (2023).

***Liphistius hintung* Sivayyapram & Warrit, sp. nov.**
https://zoobank.org/05DD8E71-5B21-4756-ACB9-9A1C3B5E62F3
Figs 1, 8, 9, 14

Type material. ***Holotype*:** THAILAND • 1♂; Nakhon Nayok, Mueang Nakhon Nayok District, Hin Tung; alt. 90 m; 27 November 2018; D. Li, L. Yu V. Sivayyapram leg.; ARA-2018-299. ***Allotype*:** THAILAND • 1♀; same data as for the holotype; ARA-2018-296. ***Paratype*:** THAILAND • 1 juvenile; same data as for the holotype; ARA-2018-297.

Diagnosis. *Liphistius hintung* sp. nov. is similar to *L. kaengkhoi* sp. nov., *L. buyphradi* sp. nov., *L. champakpheaw* sp. nov., and *L. suwat* in its general appearance. *Liphistius hintung* sp. nov. is closely similar to *L. kaengkhoi* sp. nov. but can be distinguished by the male palp: tegulum with coarser proximal dental edge and longer paraembolic plate (Figs 7A–D, 9A–D). The female *L. hintung* sp. nov. is difficult to distinguish from those of the L. *kaengkhoi* sp. nov., *L. buyphradi* sp. nov., *L. champakpheaw* sp. nov., and *L. suwat* Schwendinger, 1996. Molecular phylogeny and species delimitation using *COI* and multi-locus data support monophyly and species status of all new species described here (Sivayyapram et al. 2023).

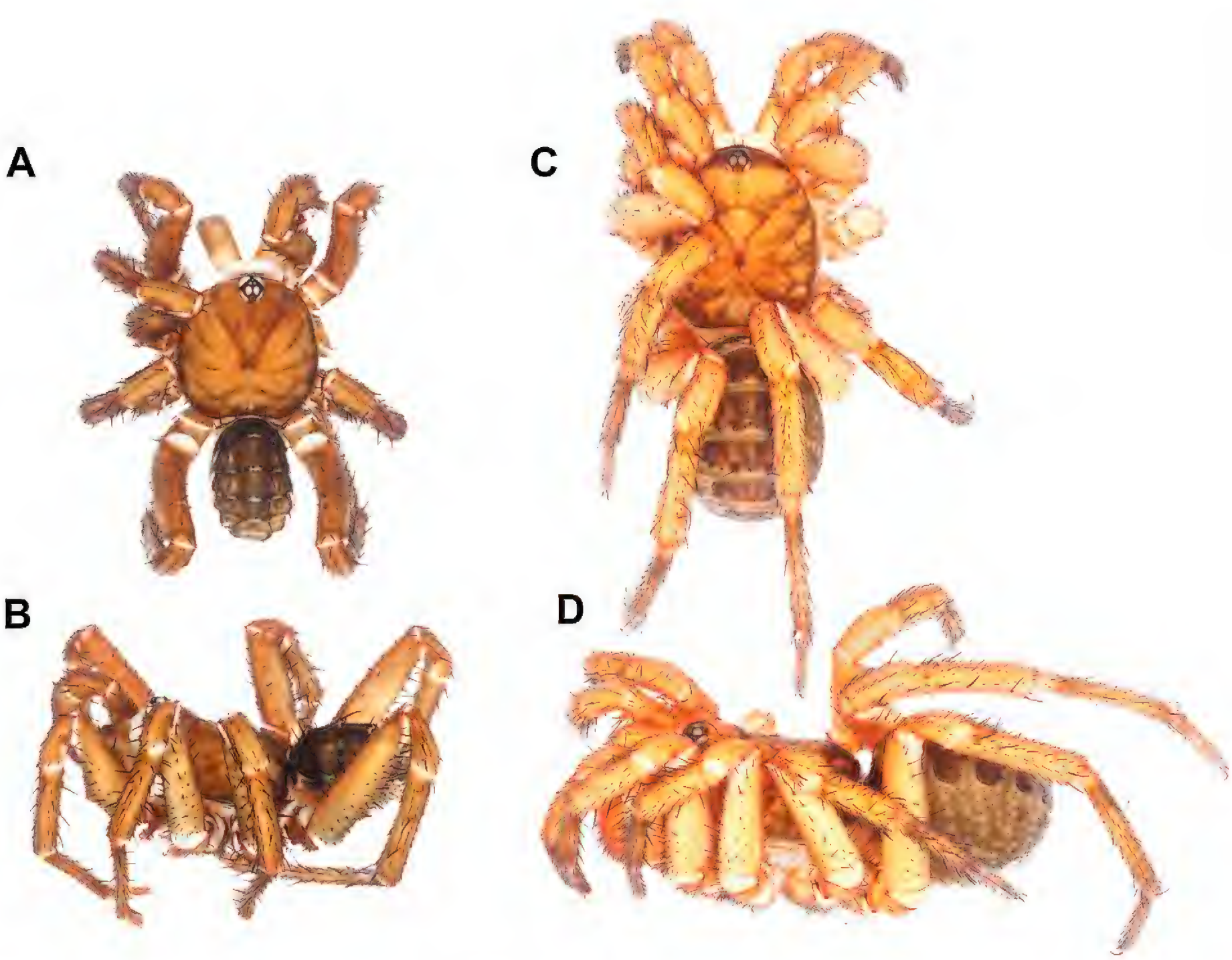

Figure 8. *Liphistius hintung* sp. nov. **A, B** male ARA-2018-299 (holotype) **C, D** female, ARA-2018-296 (allotype) **A, C** dorsal view **B, D** lateral view. Scale bar: 10 mm.

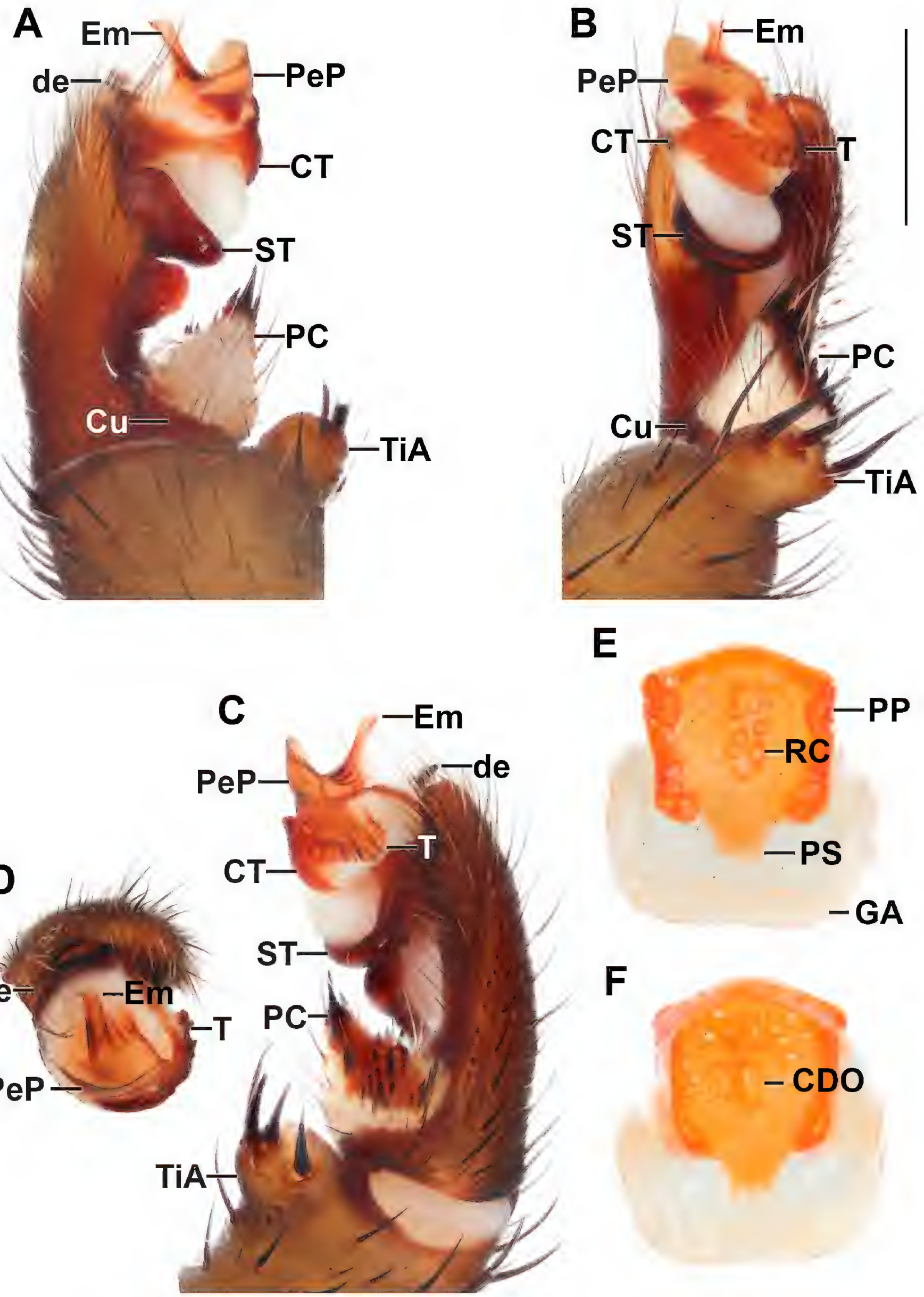

Figure 9. *Liphistius hintung* sp. nov. male palp and vulva plate **A–D** ARA-2018-299 (holotype) palp **A** prolateral view **B** ventral view **C** retrolateral view **D** distal view **E, F** ARA-2018-296 (allotype) vulva plate **E** ventral view **F** dorsal view. Abbreviations: CDO = central dorsal opening; CT = contrategulum; Cu = cumulus; de = distal edge of the contrategulum; Em = embolus; GA = genital atrium; mm = millimeter; PC = paracymbium; PeP = paraembolic plate; PP = poreplate; PS = posterior stalk; RC = receptacular cluster; ST = subtegulum; T = tegulum; TiA = tibial apophysis. Scale bar: 1 mm.

Description. Male (Holotype: ARA-2018-299; Fig. 8A, B). ***Coloration (in alcohol)*:** carapace pale brown, with black stripe along the lateral and posterior margins; abdominal tergites almost black, paler on the posterior ones; membranous part of the opisthosoma cream in color with black mottled spots; chelicerae olive green, paler at the proximal part; palp and legs uniformly brown.

Palp (Fig. 9A–D): tibial apophysis pronounce, carrying one long slender and three tapering megaspines; paracymbium conical, dark patch with spicules isolated by a pale band; cumulus plain, bearing some bristles; subtegulum without apophysis; contrategulum without apophysis, distal edge of contrategulum long and thick, slightly concave leading to the blunt apex; tegulum large, indistinctly separated from the contrategulum, axe-blade shaped, proximal margin with moderate long, coarsely dentate edge, distal margin oblique with large apophysis; pigmental bridge between the tegulum and contrategulum distinct; paraembolic plate projected into scale-like plate, basally wide with long and pointed distal edge; embolus proper: sclerotized part with two longitudinal ridges running to the truncate apex.

***Measurements*:** Total length 12.09; carapace 6.76 long, 6.37 wide; opisthosoma 5.33 long, 3.64 wide; ocular tubercle 1.17 long, 1.17 wide; palpal coxa 2.21 long, 1.56 wide; labium 0.78 long, 1.82 wide; sternum 3.64 long, 1.95 wide (1.04 on ventral surface); palp 12.35 long (3.90 + 2.34 + 4.03 + – + 2.08); leg I 19.37 long (5.85 + 2.99 + 3.90 + 4.42 + 2.21); leg II 19.89 long (5.72 + 2.73 + 4.03 + 5.20 + 2.21); leg III 22.88 long (6.11 +3.12 + 4.55 + 6.37 + 2.73); leg IV 27.81 long (7.14 + 3.25 + 5.72 + 8.45 + 3.25).

Female (Allotype: ARA-2018-296; Fig. 8C, D). ***Coloration (in alcohol)*:** carapace orange, with black marking behind the ocular tubercle running to the fovea and coxal elevations and black stripe along the carapace margins, thicker on the anterior margin; abdominal tergites pale brown with large black marking; membranous part of the opisthosoma cream colored with mottled black spots; palp and legs orange with black annulations on the metatarsus and tarsus.

Vulva (Fig. 9E, F): vulva plate hexagonal; genital atrium with a few hairs; posterior stalk trapezoidal, wider anteriorly; pore plate almost square, lateral margins thickened and projected into a lip, bearing indistinct anterolateral lobes; anterior margin convex, less thicken and not project into a lip; receptacular clusters racemose, longer than wide; central dorsal opening wide, longer than wide.

***Measurements*:** Total length 16.90; carapace 8.06 long, 7.02 wide; opisthosoma 8.32 long, 6.63 wide; ocular tubercle 1.17 long, 1.17 wide; palpal coxa 2.60 long, 1.43 wide; labium 1.04 long, 2.08 wide; sternum 3.77 long, 2.60 wide (1.56 on ventral surface); palp 13.91 long (4.94 + 2.47 + 3.38 + – + 3.12); leg I 16.90 long (5.59 + 3.12 + 3.38 + 3.12 + 1.69); leg II 17.81 long (5.72 + 2.99 + 3.77 + 3.51 + 1.82); leg III 18.72 long (5.59 + 3.12 + 3.77 + 4.16 + 2.08); leg IV 26.26 long (7.54 + 3.51 + 5.20 + 6.63 + 3.38).

Etymology. The specific epithet *hintung* refers to Hintung District, the type locality of the new species in Nakhon Nayok, Thailand.

Distribution. Known only from the type locality.

Comment. This new species name was mentioned as *Liphistius* sp. WTK in Sivayyapram et al. (2023)

***Liphistius buyphradi* Sivayyapram & Warrit, sp. nov.**
https://zoobank.org/FFFB3423-C421-48AE-858F-6D1B8D169082
Figs 1, 10, 11, 14

Type material. ***Holotype*:** Thailand • 1♂; Saraburi, Mueang Saraburi District, Nong Pla Lai; alt. 90 m; 17 August 2017; N. Warrit, V. Sivayyapram, C. Kunsete, N. Chatthanabun, P. Traiyasut leg.; ARA-2017-139. ***Allotype*:** Thailand • 1♀; same data as for the holotype; ARA-2017-140. ***Paratype*:** Thailand • 1♀; same data as for the holotype; ARA-2017-138.

Diagnosis. *Liphistius buyphradi* sp. nov. is similar to *L. kaengkhoi* sp. nov., *L. champakpheaw* sp. nov., *L. hintung* sp. nov. and *L. suwat* in its general appearance. The male of *L. buyphradi* sp. nov. can be distinguished from those species, except for *L. champakpheaw* sp. nov., by the male palp with flat paracymbium (Fig. 14; Schwendinger 1996: fig. 43A); and from *L. champakpheaw* sp. nov. by the male palp with proximal edge of the tegulum moderately long, arched, and finely dentate (short, oblique in *L. champakpheaw* sp. nov.; Fig. 13C). The female *L. buyphradi* sp. nov. is difficult to distinguish from those of the *L. kaengkhoi* sp. nov., *L. champakpheaw* sp. nov., *L. hintung* sp. nov. and *L. suwat* Schwendinger, 1996. Molecular phylogeny and species delimitation using *COI* and multi-locus data support monophyly and species status of all new species described here (Sivayyapram et al. 2023).

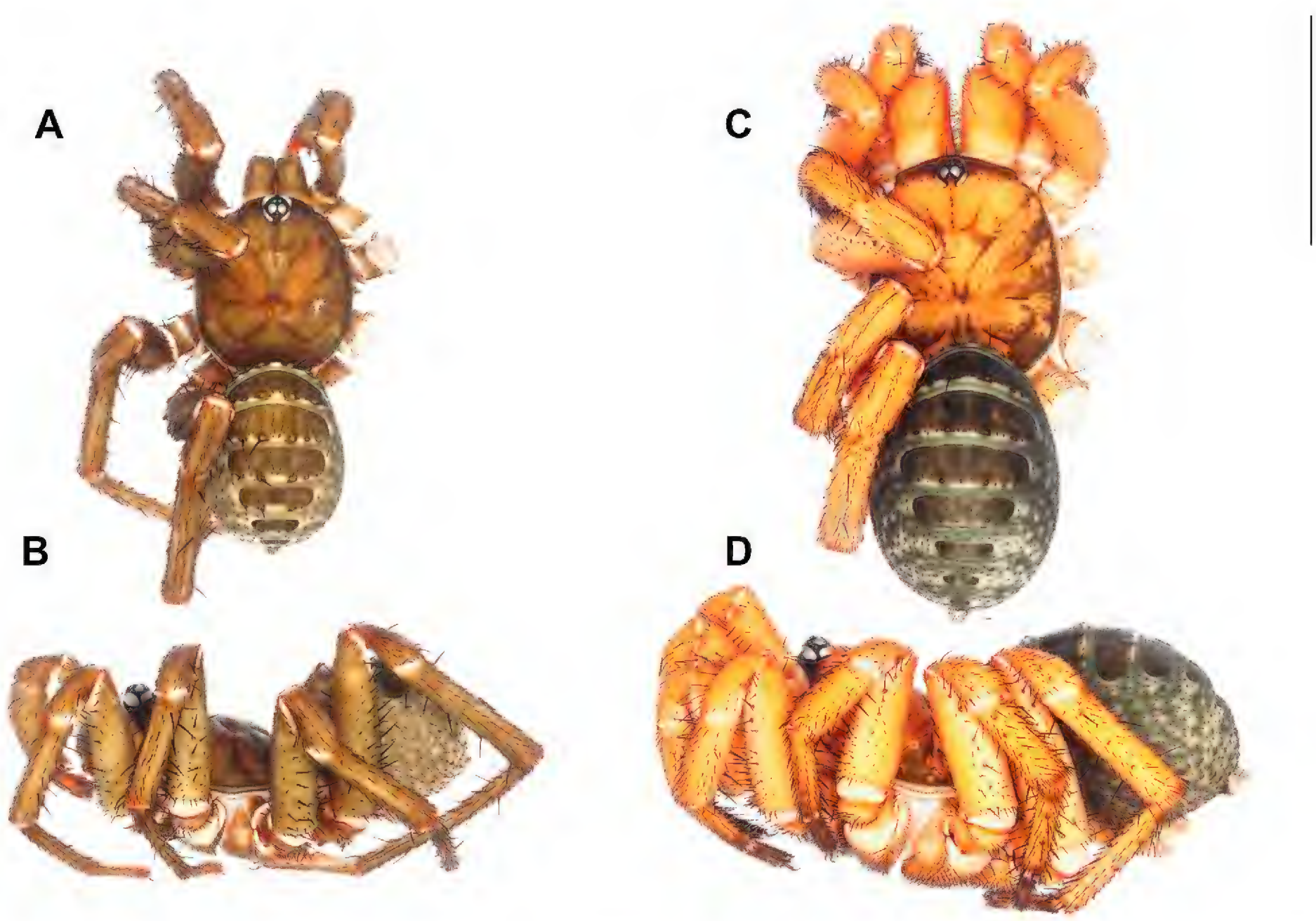

Figure 10. *Liphistius buyphradi* sp. nov. **A, B** male ARA-2017-139 (holotype) **C, D** female, ARA-2017-140 (allotype) **A, C** dorsal view **B, D** lateral view. Scale bar: 10 mm.

Description. Male (Holotype: ARA-2017-139; Fig. 10A, B). ***Coloration (in alcohol)*:** carapace brown with black stripe along the margins; abdominal tergite olive green, except on the white posterior margins; membranous parts of the opisthosoma cream colored with black mottled spots; chelicerae olive green, paler on the proximal part; palp and legs olive green, without distinct annulation.

Palp (Fig. 11A–D): tibial apophysis round, carrying one long slender and three tapering megaspines; paracymbium round but flat, dark patch with spicules isolated by a pale band; cumulus plane, bearing long black bristles; subtegulum without apophysis; contrategulum without apophysis, distal edge of contrategulum narrow with a depression leading to the oblique conical dorsal apex; tegulum large, axe-blade shaped, possessing a long ridge on the surface, indistinctly separated from the contrategulum, proximal margin with arched, moderately dentate edge, distal margin oblique with moderately apophysis; pigmental bridge between tegulum and contrategulum distinct; paraembolic plate round, as long as wide, project into scale like-plate; embolus proper: sclerotized part with two longitudinal ridges reaching to the tip.

***Measurements*:** Total length 15.60; carapace 7.80 long, 7.28 wide; opisthosoma 8.19 long, 7.02 wide; ocular tubercle 1.04 long, 1.04 wide; palpal coxa 2.10 long, 1.17 wide; labium 0.72 long, 1.44 wide; sternum 3.92 long, 2.16 wide (1.02 on ventral surface); palp 12.48 long (4.14 + 2.34 + 3.90 + – + 2.10); leg I 20.88 long (6.06 + 3.00 + 4.26 + 5.22 + 2.34); leg II 22.62 long (6.24 + 3.12 + 5.16 + 7.14 + 2.64); leg III 24.66 long (6.60 + 3.12 + 5.16 + 7.14 + 2.64); leg IV 31.44 long (8.22 + 3.30 + 6.54 + 9.66 + 3.72).

Female (Allotype: ARA-2017-140; Fig. 10C, D). ***Coloration (in alcohol)*:** carapace orange with black marking behind the ocular tubercle and on the peripheral area of the thoracic region; abdominal tergites black, except on the white posterior margins; membranous part of the opisthosoma cream colored with black mottled spots; chelicerae orange, paler at the proximal part; palp and leg femora to metatarsi orange, distal part of metatarsi I–III with black mottled marking, tarsi I–III black, tarsi IV orange with black annulations on the proximal and distal parts.

Vulva (Fig. 12E, F): vulva plate almost round; genital atrium with lateral hairs; posterior stalk narrow, V-shaped; pore plate quadrangular slightly wider than long; lateral margins thickened, projected into a lip, bearing moderate anterolateral lobes; anterior margin arched, thickened, not projected into a lip; receptacular cluster racemose; central dorsal opening wide.

***Measurements*:** Total length 24.70; carapace 10.66 long, 8.97 wide; opisthosoma 12.35 long, 8.84 wide; ocular tubercle 1.04 long, 1.04 wide; palpal coxa 3.24 long, 2.88 wide; labium 1.16 long, 2.48 wide; sternum 5.36 long, 2.80 wide (1.76 on ventral surface); palp 16.90 long (5.80 + 3.40 + 3.90 + – + 3.80); leg I 20.20 long (6.90 + 3.90 + 4.00 + 3.50 + 1.90); leg II 20.40 long (6.60 + 3.80 + 4.10 + 4.10 + 1.80); leg III 22.30 long (6.80 + 4.00 + 4.10 + 5.00 + 2.40); leg IV 30.80 long (8.40 + 4.20 + 6.10 + 8.20 + 3.90).

Etymology. The specific epithet *buyphradi* is dedicated to Mr. Phuri Buyphrad for providing information on the type locality of the new species.

Distribution. Known only from the type locality.

Comment. This new species name was mentioned as *Liphistius* sp. SL in Sivayyapram et al. (2023).

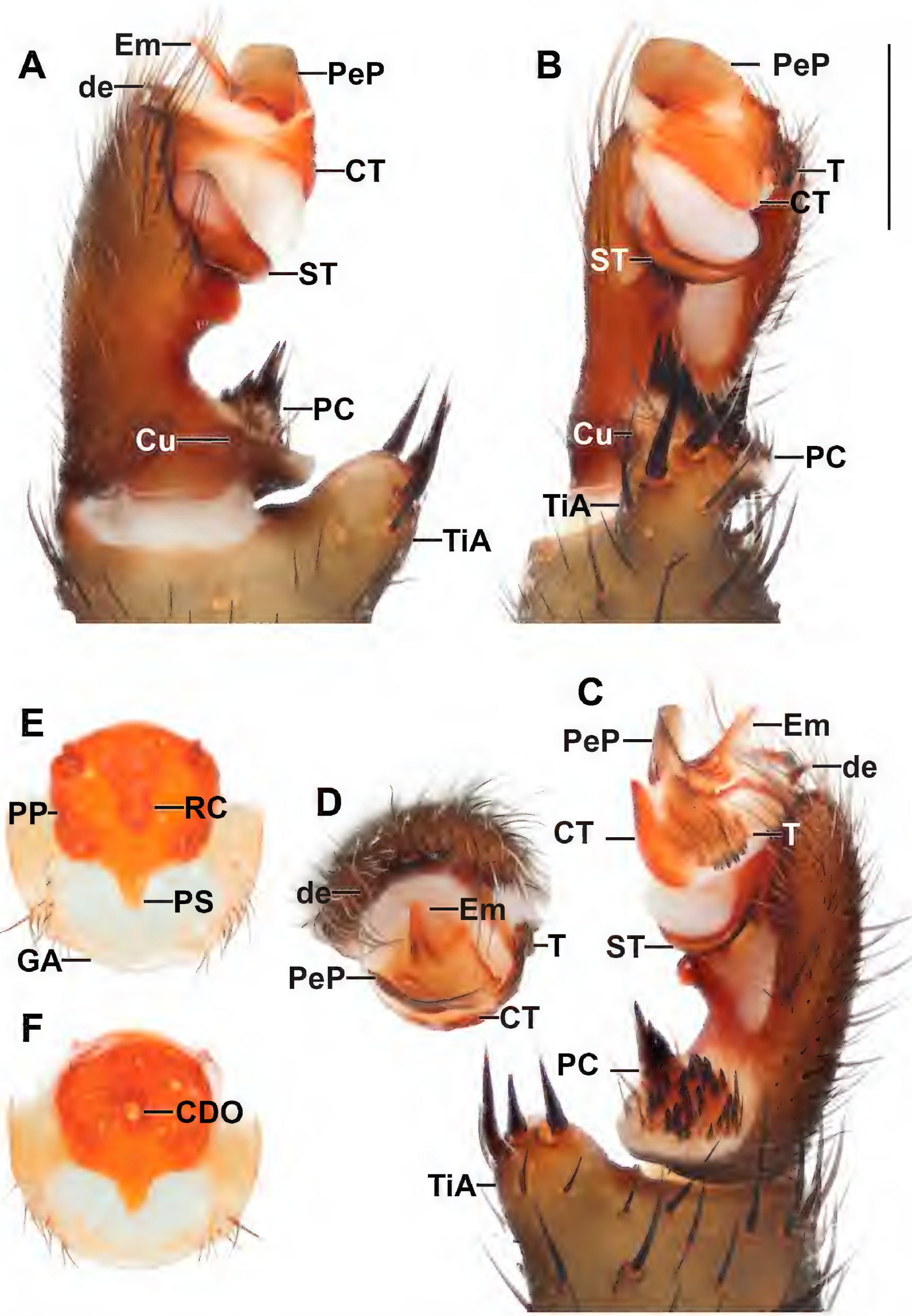

Figure 11. *Liphistius buyphradi* sp. nov. male palp and vulva plate **A–D** ARA-2017-139 (holotype) palp **A** prolateral view **B** ventral view **C** retrolateral view **D** distal view **E, F** ARA-2017-140 (allotype) vulva plate **E** ventral view **F** dorsal view. Abbreviations: CDO = central dorsal opening; CT = contrategulum; Cu = cumulus; de = distal edge of the contrategulum; Em = embolus; GA = genital atrium; mm = millimeter; PC = paracymbium; PeP = paraembolic plate; PP = poreplate; PS = posterior stalk; RC = receptacular cluster; ST = subtegulum; T = tegulum; TiA = tibial apophysis. Scale bar: 1 mm.

***Liphistius champakpheaw* Sivayyapram & Warrit, sp. nov.**
https://zoobank.org/AB4110C0-8320-4090-BDAA-8C390A0584D4
Figs 1, 12–14

Type material. ***Holotype*:** Thailand • 1♂; Saraburi, Kaeng Khoi District, Cham Phak Phaeo; alt. 82 m; 19 August 2017; N. Warrit, V. Sivayyapram, C. Kunsete, N. Chatthanabun, P. Traiyasut leg.; ARA-2017-146. ***Allotype*:** Thailand • 1♀; same data as for the holotype; ARA-2017-146a.

Diagnosis. *Liphistius champakpheaw* sp. nov. is similar to *L. kaengkhoi* sp. nov., *L. hintung* sp. nov., *L. buyphradi* sp. nov., and *L. suwat* in its general appearance. *Liphistius champakpheaw* sp. nov. is closely similar to *L. buyphradi* sp. nov. but can be distinguished by the male palp with tegulum that is short, obliqued, with dentate proximal edge (moderately long, arched in *L. buyphradi* sp. nov., Fig. 11C). The female *L. champakpheaw* sp. nov. is difficult to distinguish from those of the *L. kaengkhoi* sp. nov., *L. hintung* sp. nov., *L. buyphradi* sp. nov., and *L. suwat* Schwendinger, 1996. Molecular phylogeny and species delimitation using *COI* and multi-locus data support monophyly and species status of all new species described here (Sivayyapram et al. 2023).

Description. Male (Holotype: ARA-2017-146; Fig. 12A, B). ***Coloration (in alcohol)*:** carapace brown, slightly paler in the central area, without any distinct markings;

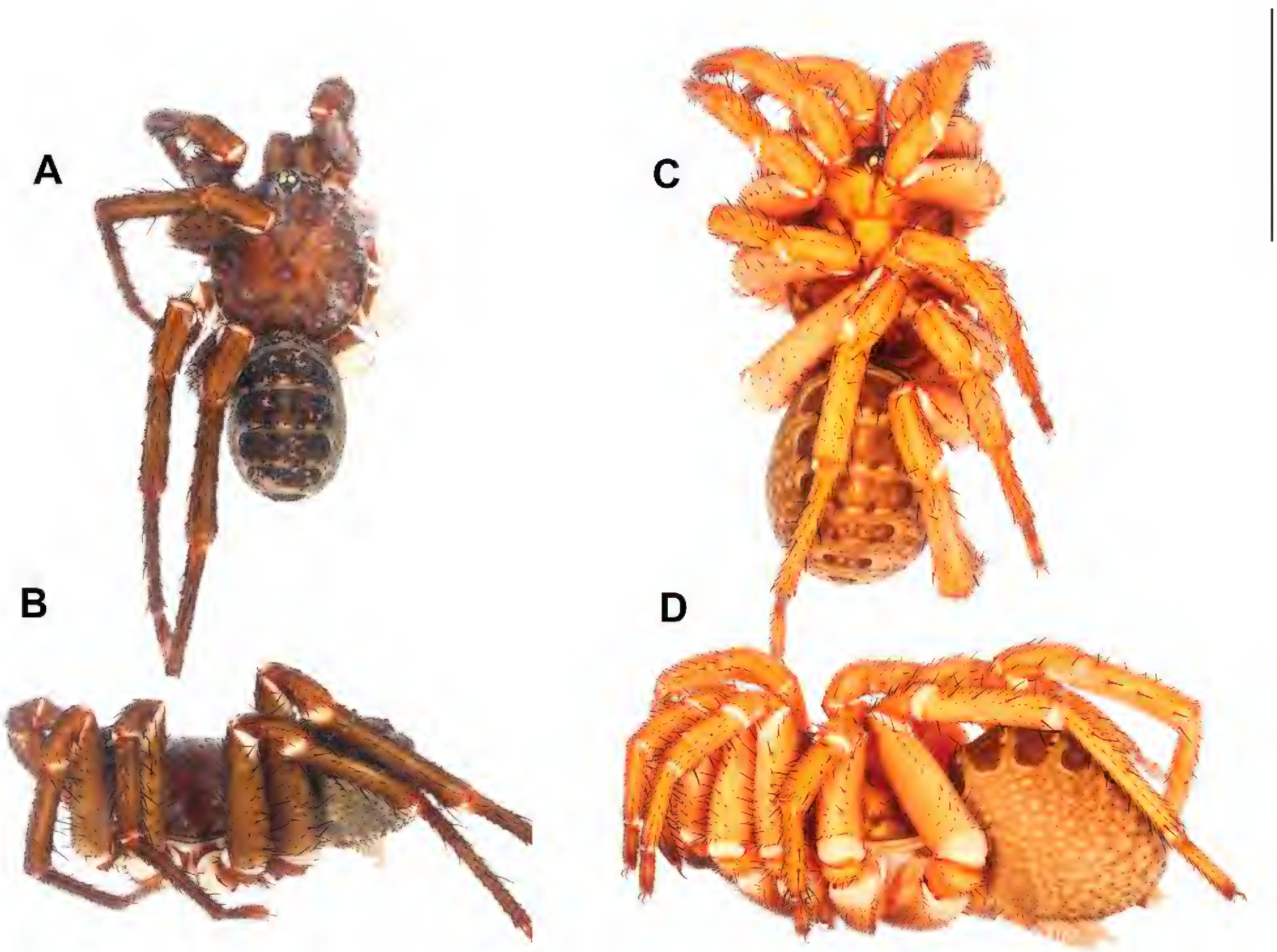

Figure 12. *Liphistius champakpheaw* sp. nov. **A, B** male ARA-2017-146 (holotype) **C, D** female, ARA-2017-146a (allotype) **A, C** dorsal view **B, D** lateral view. Scale bar: 10 mm.

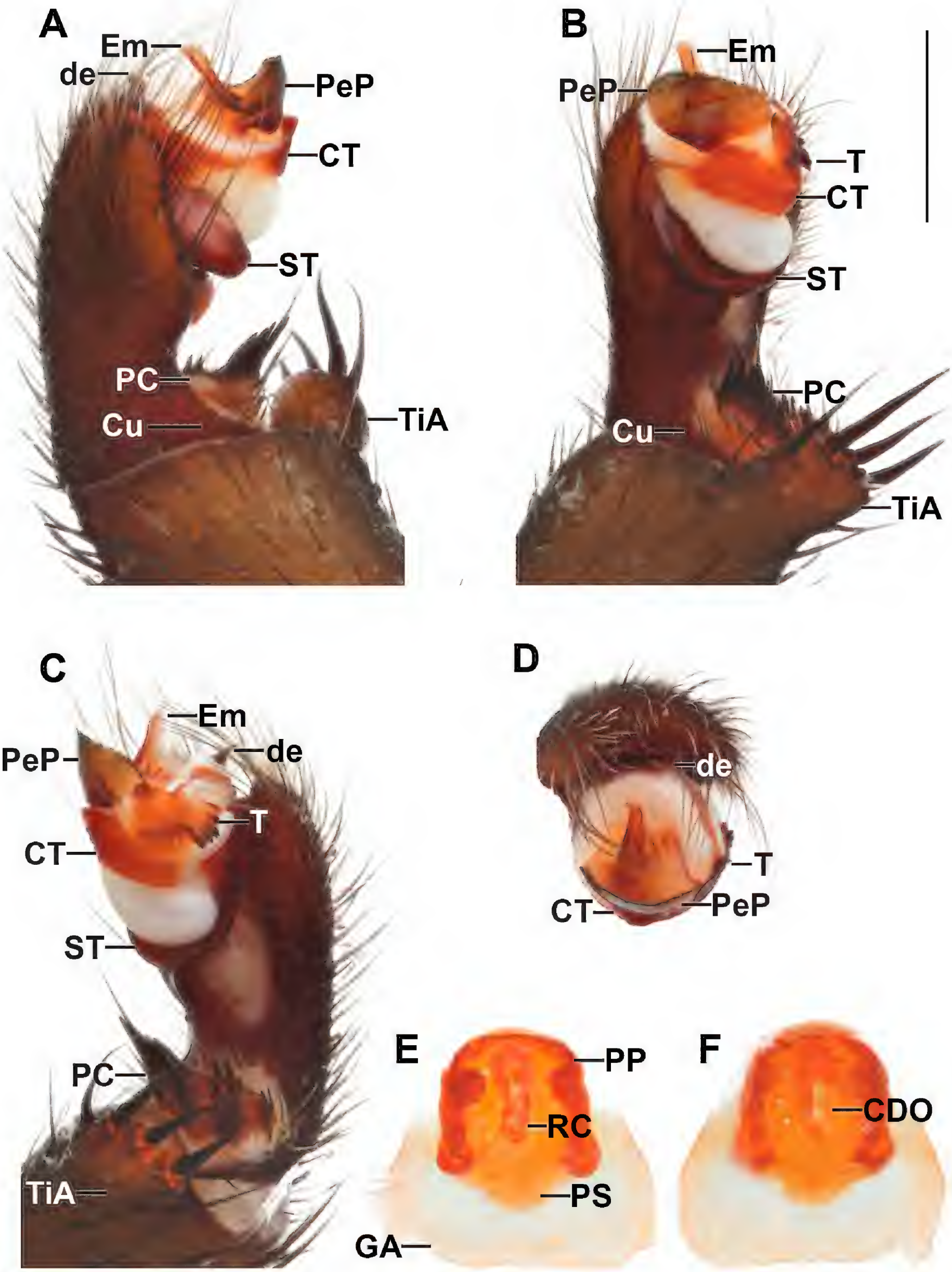

Figure 13. *Liphistius champakpheaw* sp. nov. male palp and vulva plate **A–D** ARA-2017-146 (holotype) palp **A** prolateral view **B** ventral view **C** retrolateral view **D** distal view **E, F** ARA-2018-146a (allotype) vulva plate **E** ventral view **F** dorsal view. Abbreviations: CDO = central dorsal opening; CT = contrategulum; Cu = cumulus; de = distal edge of the contrategulum; Em = embolus; GA = genital atrium; mm = millimeter; PC = paracymbium; PeP = paraembolic plate; PP = poreplate; PS = posterior stalk; RC = receptacular cluster; ST = subtegulum; T = tegulum; TiA = tibial apophysis. Scale bar: 1 mm.

Figure 14. Left to right: *Liphistius kaengkhoi* sp. nov., *Liphistius hintung* sp. nov., *Liphistius buyphradi* sp. nov., and *Liphistius champakpheaw* sp. nov. **A** male dorsal view **B** male palp **C** female dorsal view **D** vulva plate. Scale bars: 10 mm (**A, C**); 1 mm (**B, D**).

abdominal tergites black, except for cream colored spots on the posterior margin; membranous part of the opisthosoma cream colored with black mottled spots; chelicerae olive green, paler at the proximal part; palp and legs uniformly brown.

Palp (Fig. 13A–D): tibial apophysis wide distally, carrying four tapering megaspines; paracymbium round but flat, dark patch with spicules isolated by a pale band; cumulus plain, bearing several long bristles; subtegulum without apophysis; contrategulum without apophysis, distal edge of the contrategulum long with slight concavity leading to the truncate apex; tegulum moderate, proximal margins with short, tooth-like coarsely dentate edge; distal margin oblique, with large apophysis; paraembolic plate projected into scale-like plate, large, basally wide, running to blunt distal margin; embolus proper: sclerotized part with two longitudinal ridges reaching to the tip.

***Measurements*:** Total length 14.82; carapace 7.54 long, 7.02 wide; opisthosoma 7.41 long, 5.46 wide; ocular tubercle 1.17 long, 1.43 wide; palpal coxa 2.10 long, 1.17 wide; labium 0.78 long, 1.30 wide; sternum 3.90 long, 3.64 wide (1.17 on ventral surface); palp 12.22 long (4.03 + 1.56 + 4.42 + – + 2.21); leg I 23.53 long (6.89 + 2.86 + 5.07 + 6.24 + 2.47); leg II 24.83 long (7.02 + 2.99 + 5.07 + 6.76 + 2.99); leg III 28.34 long (7.28 + 3.38 + 5.72 + 8.32 + 3.64); leg IV 34.84 long (8.84 + 3.51 + 7.15 + 10.92 + 4.42).

Female (Allotype: ARA-2017-146a; Fig. 12C, D). ***Coloration (in alcohol)*:** carapace orange with black markings on the coxal elevations and the carapace margins; abdominal tergites with black markings except for the cream color on the posterior margin; membranous part of the opisthosoma cream colored with mottled black spots; chelicerae orange; palp and legs orange with black annulation on the proximal and distal part of tarsi.

Vulva (Fig. 13E, F): vulva plate triangular, as long as wide; genital atrium with a few hairs and wrinkle posterior margin; posterior stalk U-shape, short but wide; pore plate quadrangular, slightly longer than wide; lateral margins thickened and projected into lips, bearing moderate anterolateral lobe; anterior margin arched, less thickened but not projected into a lip; receptacular cluster racemose longer than wide; central dorsal opening longer than wide.

***Measurements*:** Total length 19.37; carapace 9.23 long, 7.41 wide; opisthosoma 9.88 long, 8.06 wide; ocular tubercle 1.17 long, 1.56 wide; palpal coxa 3.25 long, 2.08 wide; labium 1.17 long, 2.47 wide; sternum 5.07 long, 2.86 wide (1.69 on ventral surface); palp 15.73 long (5.59 + 3.12 + 3.77 + – + 3.25); leg I 18.72 long (6.24 + 3.51 + 3.77 + 3.38 + 1.82) leg II 18.59 long (5.72 + 3.38 + 3.77 + 3.90 + 1.82); leg III 20.15 long (6.11 + 3.38 + 3.90 + 4.42 + 2.34); leg IV 28.99 long (8.32 + 3.90 + 5.59 + 7.80 + 3.38).

Etymology. The specific epithet *champakpheaw* refers to Cham Pak Pheaw subdistrict, the type locality of the new species in Saraburi, Thailand.

Distribution. Known only from the type locality.

Comment. This new species name was mentioned as *Liphistius* sp. CPP in Sivayyapram et al. (2023).

Discussion

Here we described seven new *Liphistius* species can be assigned to two species groups, the *bristowei* group and the *trang* group, based on the characteristics of male and female genitalia.

The *bristowei* group

Liphistius dawei sp. nov. is assigned to the *bristowei* group by the male palp with an elevated cumulus, adjoining the embolus with the sclerotized part bearing two longitudinal ridges reaching to the tip, the paraembolic plate not projected into a scale-like plate, the subtegulum with an apophysis; and the vulva with projected corners of the pore plate. However, the vulva bears a unique posterior stalk constricted at the base which is more similar to the species belonging to the *birmanicus* group. *Liphistius choosaki* sp. nov. and *L. lansak* sp. nov. are also assigned to the *bristowei* group according to the vulva plate having a wide posterior stalk. The males of the two latter species are unknown.

The *trang* group

Liphistius kaengkhoi sp. nov., *L. hintung* sp. nov., *L. buyphradi* sp. nov., and *L. champakpheaw* sp. nov. are assigned to the *trang* group based on the characters of a detached embolus, a paraembolic plate projected to scale-like plate, the tegulum with a prominent distal margin, the subtegulum without an apophysis; and the vulva with small central dorsal opening and receptacular clusters. Specifically, all species are attributed to the complex A of the *trang* group according to the male palp with a plain cumulus, the contrategulum without an apophysis; and the female with an orange carapace and femora, the vulva with a square pore plate, a U-shape posterior stalk, and a racemose receptacular cluster.

Acknowledgements

We thank numerous people for their assistance, support, and advice during the field work: Chawatat Thanoosing, Chaowalit Songsangchote, Fengxiang Liu, Long Yu, Nontawat Chatthanabun, Pakorn Nalinrachatakan, Phanuwutt Senawong, Pratchaya Pramoj Na Ayutthaya, Puttita Pasukdee, Sirat Lertjintanakit, Teeradate Srimaneeyanon, Thitiya Tuntrakoon, Wasin Nawanetiwong.

We also thank Dr. Robert J Raven from University of Southern Queensland, Australia for his graceful kindness helping VS and CK to appreciate the world of spider morphology.

We thank the director of the Forest Research Institute, Forest Department, Ministry of Natural Resources and Environmental Conservation, Myanmar and Dr. Nobuyuki Tanaka, National Museum of Nature and Science, Japan for their support and permission for the biological inventory in Myanmar based on MOU between both countries.

We would like to thank the Plant Genetic Conservation Project under the Royal Initiative and the Department of National Park, Wildlife, and Plant Protection, Thailand for providing us access for specimen collecting in the last years.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

Funding

This research was supported by the 100th Anniversary Chulalongkorn University for Doctoral Scholarship and Overseas Research Experience Scholarship for Graduate Student fund to VS, the 90th Anniversary of Chulalongkorn University, Rachadapisek Sompote Fund (GCUGR1125641020D) to VS and NW and The National Science and Technology Development Agency (NSTDA) Fund, Thailand to NW.

Author contributions

Conceptualization: VS, NW, DRS. Data curation: CK, NW, XX, SD, PT, DL, VS. Formal analysis: NW, VS. Funding acquisition: NW. Investigation: DL, VS, CK, PT, SD, NW, DRS. Methodology: NW, XX, DL, VS, DRS, PT. Project administration: NW. Resources: SD, CK, PT, DL, XX, MMA, HO, NW. Supervision: DRS. Validation: NW, XX, VS, DL. Visualization: NW, VS, DRS. Writing – original draft: NW, VS, DRS. Writing – review and editing: DL, VS, DRS, XX, MMA, PT, NW, CK, HO, SD.

Author ORCIDs

Varat Sivayyapram https://orcid.org/0000-0002-8466-0270
Xin Xu https://orcid.org/0000-0001-5632-6622
Deborah R. Smith https://orcid.org/0000-0002-2581-5009
Hirotsugu Ono https://orcid.org/0000-0002-8568-4549
Daiqin Li https://orcid.org/0000-0001-8269-7734
Natapot Warrit https://orcid.org/0000-0002-6338-1782

Data availability

All of the data that support the findings of this study are available in the main text.

References

Ono H (1988) Liphistiid spiders (Araneae, Mesothelae) of northwest Thailand. Bulletin of the National Science Museum: Series A : Zoology 14(1): 35–41.

Platnick NI, Gertsch WJ (1976) The suborders of spiders: A cladistic analysis (Arachnida, Araneae). American Museum Novitates 2607: 1–15.

Platnick NI, Sedgwick WC (1984) A revision of the spider genus *Liphistius* (Araneae, Mesothelae). American Museum Novitates 2781: 1–31.

Schwendinger PJ (1990) On the spider genus *Liphistius* (Araneae: Mesothelae) in Thailand and Burma. Zoologica Scripta 19(3): 331–351. https://doi.org/10.1111/j.1463-6409.1990.tb00262.x

Schwendinger PJ (1996) New *Liphistius* species (Araneae, Mesothelae) from western and eastern Thailand. Zoologica Scripta 25(2): 123–141. https://doi.org/10.1111/j.1463-6409.1996.tb00155.x

Schwendinger PJ (2017) A revision of the trapdoor spider genus *Liphistius* (Mesothelae: Liphistiidae) in peninsular Malaysia; part 1. Revue Suisse de Zoologie 124: 391–445. https://doi.org/10.5281/zenodo.893555

Schwendinger PJ, Ono H (2011) On two *Heptathela* species from southern Vietnam, with a discussion of copulatory organs and systematics of the Liphistiidae (Araneae: Mesothelae). Revue Suisse de Zoologie 118: 599–637. https://doi.org/10.5962/bhl.part.117818

Schwendinger PJ, Syuhadah N, Lehmann-Graber C, Price L, Huber S, Hashim R, Bhassu S, Monod L (2019) A revision of the trapdoor spider genus *Liphistius* (Mesothelae: Liphistiidae) in Peninsular Malaysia; part 2. Revue Suisse de Zoologie 126: 321–353. https://doi.org/10.5281/zenodo.3463473

Schwendinger PJ, Huber S, Lehmann-Graber C, Ono H, Aung MM, Hongpadharakiree K (2022) A taxonomic revision of the *Liphistius birmanicus*-group (Araneae: Liphistiidae) with the description of five new species. Revue Suisse de Zoologie 129(2): 375–424. https://doi.org/10.35929/RSZ.0083

Selden PA (1996) First fossil mesothele spider, from the Carboniferous of France. Revue Suisse de Zoologie 2: 585–596.

Selden PA, Ren D (2017) A review of Burmese amber arachnids. The Journal of Arachnology 45(3): 324–343. https://doi.org/10.1636/JoA-S-17-029

Sivayyapram V, Kunsete C, Xu X, Smith DR, Traiyasut P, Deowanish S, Li D, Warrit N (2023) Molecular phylogeny, biogeography, and species delimitation of segmented spider genus *Liphistius* (Araneae: Liphistiidae) in Thailand. Zoological Journal of the Linnean Society, zlad149. https://doi.org/10.1093/zoolinnean/zlad149

World Spider Catalog (2023) World Spider Catalog. Version 23.0. Natural History Museum Bern.

Xu X, Liu F, Chen J, Ono H, Li D, Kuntner M (2015a) A genus-level taxonomic review of primitively segmented spiders (Mesothelae, Liphistiidae). ZooKeys 488: 121–151. https://doi.org/10.3897/zookeys.488.8726

Xu X, Liu F, Cheng R-C, Chen J, Xu X, Zhang Z, Ono H, Pham DS, Norma-Rashid Y, Arnedo MA, Kuntner M, Li D (2015b) Extant primitively segmented spiders have recently diversified from an ancient lineage. Proceedings of the Royal Society B: Biological Sciences 282(1808): 20142486. https://doi.org/10.1098/rspb.2014.2486

Xu X, Su Y-C, Ho SY, Kuntner M, Ono H, Liu F, Chang C-C, Warrit N, Sivayyapram V, Aung KPP, Pham DS, Norma-Rashid Y, Li D (2021) Phylogenomic analysis of ultraconserved elements resolves the evolutionary and biogeographic history of segmented trapdoor spiders. Systematic Biology 70(6): 1110–1122. https://doi.org/10.1093/sysbio/syaa098

Yu K, Zhang F, Zhang J-X (2021) First new species of the genus *Liphistius* Schiödte, 1849 from China (Araneae: Liphistiidae). Acta Arachnologica Sinica 30: 36–40. https://doi.org/10.3969/j.issn.1005-9628.2021.01.006

Zhan Y, Sivayyapram V, Liu F, Li D, Xu X (2022) Three new species of the spider genus *Liphistius* (Araneae, Mesothelae, Liphistiidae) from Thailand. ZooKeys 1104: 115–128. https://doi.org/10.3897/zookeys.1104.83264